

U.S. Department of Energy

**Radionuclide Air Emissions
Annual Report
Final**

Calendar Year 1999

**Rocky Flats Environmental
Technology Site**

ADMIN RECORD

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167

SW-A-005670

U.S. Department of Energy

Radionuclide Air Emissions Annual Report for Calendar Year 1999

Prepared in accordance with
40 CFR 61, Subpart H
and
CAQCC Regulation No. 8, Part A, Subpart H

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Executive Summary

As required by Title 40 of the Code of Federal Regulations (CFR), Part 61, Subpart H, and Colorado Air Quality Control Commission Regulation No. 8, Part A, Subpart H, the radiation dose to the public from the Rocky Flats Environmental Technology Site (Site) is determined annually and reported to the U.S. Environmental Protection Agency (EPA) and the Colorado Department of Public Health and Environment (CDPHE). These regulations limit the air pathway dose from Site activities to any member of the public to an annual effective dose equivalent (EDE) of 10 millirem (mrem).

For comparison, the average annual EDE for residents of the Denver area from all sources of radiation is approximately 420 mrem, over 80% of which is due to natural background radiation (Roberts, 1998). The health risk associated with 1 mrem of EDE from naturally occurring sources of background radiation (such as uranium or thorium in rock or soil, cosmic rays, and radon emitted from soil or bedrock) is the same as that produced from anthropogenic sources of radiation, such as Site activities or medical x-rays.

Compliance with the 10 mrem standard has been determined by comparing environmental radionuclide air concentration measurements at critical receptor locations with the "Concentration Levels for Environmental Compliance" listed in Table 2 of Appendix E to 40 CFR 61, in accordance with the alternative compliance demonstration method approved by EPA and CDPHE (DOE, 1997a; DOE, 1998). Compliance is demonstrated when each measured radionuclide air concentration is less than its corresponding compliance level in Table 2 and when the "fractional sum" of all radionuclides is less than 1. For 1999, each measured radionuclide air concentration was less than 1% of the corresponding concentration level for environmental compliance and the fractional sum of all radionuclides was less than 1.5% of the allowable level at all sampling locations. The Site was in compliance with the 10 mrem standard during 1999.

Airborne radionuclides appear to have been dominated by naturally occurring uranium isotopes in 1999. At the receptors with the largest fractional sums, for example, uranium isotopes characteristic of naturally occurring uranium represented an order-of-magnitude larger dose than that contributed by nonuranium isotopes. In addition, the locations where the highest total radionuclide levels were measured in 1999 (northwest and southeast of the Site) were influenced by off-Site activities that generated dust, such as traffic or quarrying operations. These patterns are consistent with those seen from sampling results in 1997 and 1998.

For comparison, the 1999 air dose due to Site activities was also calculated using the EPA-approved CAP88-PC dispersion model, as has been done in previous years. The dose was calculated for the most impacted off-Site individual. The calculated EDE for the 1999 calendar year to this maximally exposed individual was 0.004 mrem, which is

less than 0.05% of the standard. Individuals living or working at other off-Site locations received a lower dose. The modeling results suggest that Site contributions to off-Site dose in 1999 were due to a combination of resuspended contaminated soil resulting from the 903 Pad area and project emissions from several waste management, remediation, and deactivation/demolition activities.

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Abbreviations and Acronyms

Am	Americium
ASRF	Advanced Size Reduction Facility
Ave	Avenue
Blvd	Boulevard
Bq	Becquerel(s)
CAP88-PC	Clean Air Act Assessment Package-1988 (Version 1.0)
CAQCC	Colorado Air Quality Control Commission
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Ci	Curies
Ci/m ³	Curies per cubic meter
cm	Centimeter(s)
DOE	U.S. Department Of Energy
E	East
EDE	Effective dose equivalent
EIS	Effluent Information System
ENE	East-northeast
EPA	U.S. Environmental Protection Agency
ESE	East-southeast
GIS	Geographic information system
H-3	Tritium
HEPA	High efficiency particulate air (filter)
Hwy	Highway
km	Kilometer(s)
km ²	Square kilometer(s)
m	Meter(s)
m ²	Square meter(s)
m ³	Cubic meters(s)
MEI	Maximally exposed individual
mrem	Millirem
m/s	Meters per second
mSv	MilliSievert(s)
N	North
NE	Northeast
NNE	North-northeast
NNW	North-northwest
NW	Northwest
ODIS	Off-Site Discharge Information System
pCi/m ³	Picocuries per cubic meter
Pu	Plutonium
PuSPS	Plutonium Stabilization and Packaging System
RAAMP	Radioactive Ambient Air Monitoring Program
RCRA	Resource Conservation and Recovery Act

Abbreviations and Acronyms (continued)

Rd	Road
rem	Roentgen equivalent man
RFCA	Rocky Flats Cleanup Agreement
RFFO	Rocky Flats Field Office
S	South
SE	Southeast
SEP	Solar Evaporation Ponds
Site	Rocky Flats Environmental Technology Site
SNM	Special nuclear material
SPP	Solar Ponds Plume
SSE	South-southeast
SSW	South-southwest
St	Street
Sv	Sievert(s)
SW	Southwest
TRU	Transuranic
U	Uranium
USC	United States Code
VOC	Volatile organic compound
W	West
WIPP	Waste Isolation Pilot Plant
WNW	West-northwest
WSW	West-southwest
μm	Micrometer(s)
°C	Degrees Celsius

1.0 INTRODUCTION

The Rocky Flats Environmental Technology Site (Site) is subject to *National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities* (Title 40 of the Code of Federal Regulations [CFR], Part 61, Subpart H).

Regulation 40 CFR 61, Subpart H, applies to operations at any facility owned or operated by the U.S. Department of Energy (DOE) that emits radionuclides (other than radon-222 and radon-220) into the air. The standard requires that emissions of radionuclides to the ambient air from the Site not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent (EDE) of 10 millirem (mrem) (0.1 milliSieverts [mSv]). Colorado has incorporated 40 CFR 61, Subpart H, by reference as Colorado Air Quality Control Commission (CAQCC) Regulation No. 8, Part A, Subpart H.

Regulation 40 CFR 61, Subpart H, Section 61.94, requires the Site to determine compliance with the standard for the previous calendar year and to submit this information, along with other data, to the U.S. Environmental Protection Agency (EPA) in an annual report (CAQCC Regulation No. 8, Part A, Subpart H, requires submittal to the Colorado Department of Public Health and Environment [CDPHE]). This report fulfills the reporting requirements of 40 CFR 61.94 and CAQCC Regulation No. 8, Part A, Section 61.94, for the 1999 calendar year.

In 1997, DOE filed an application with EPA and CDPHE requesting approval of an alternative compliance demonstration method for 40 CFR 61, Subpart H (DOE, 1997a). The alternative method is based on environmental measurements of radionuclide air concentrations at critical receptor locations, rather than the dispersion modeling approach outlined in the regulation itself. In cases where nonpoint sources of emissions are the primary contributors to dose, as has been the case at the Site since before 1995, such a sampling-based alternative method is recommended by EPA (EPA, 1991).

The alternative compliance demonstration method has been approved by CDPHE and EPA. The compliance sampling network, which consists of 14 samplers located around the perimeter of the Site, became fully operational in 1999. The samplers are part of the Site's Radioactive Ambient Air Monitoring Program (RAAMP) network.

Because most of the compliance demonstration samplers were in place throughout 1999, compliance has been determined using the alternative method for this annual report, as agreed to with EPA and CDPHE. For comparison, compliance has also been determined using the standard modeling approach specified in 40 CFR 61, Subpart H. This is the last year that modeling will be conducted for comparison with the alternative approach.

2.0 FACILITY INFORMATION

This section describes the Rocky Flats Environmental Technology Site, lists the radioactive materials used at the Site, and describes the handling and processing that the radioactive materials undergo. New construction or modifications in calendar year 1999 for which construction approval and startup notification were waived per 40 CFR 61.96 are also identified in this section. Construction approval and startup notification were not required for any new construction or modification in 1999.

2.1 Site Description

The Rocky Flats Environmental Technology Site is operated by Kaiser-Hill Company, L.L.C., with oversight by the Rocky Flats Field Office (RFFO) of the U.S. Department of Energy. Prior to 1989, the Site fabricated nuclear weapons components from plutonium (Pu), uranium (U), beryllium, and stainless steel. Production activities included metal fabrication and assembly, chemical recovery and purification of process-produced transuranic (TRU) radionuclides, and related quality control functions. Plutonium weapons operations were curtailed at the Site in 1989 due to safety concerns, and in February 1992, the Site's weapons production mission was discontinued. The Site is now undergoing decontamination, decommissioning, and cleanup and is moving toward final closure.

The Site occupies an area of 26.5 square kilometers (km^2) in northern Jefferson County, Colorado, about 25.7 kilometers (km) northwest of Denver. The Site is located at approximately 1,829 meters (m) above mean sea level on the eastern edge of a geological bench known locally as Rocky Flats. This bench, about 8.1 km wide in an east-west direction, flanks the eastern edge of the Rocky Mountains.

Over 2.1 million people live within 80 km of the Site. Adjacent land use is a mixture of agriculture, open space, industry, and residential housing. Surrounding communities include the city of Golden to the south of the Site; the cities of Arvada, Broomfield, and Westminster to the east; and the city of Boulder to the north. An area map is shown in Figure 2-1.

The former production facilities are located near the center of the Site within a fenced security area of 1.6 km^2 . The remaining Site area contains support facilities and serves as a buffer zone for former production facilities. A map of the Site is shown in Figure 2-2; a simplified map of the central portion of the Site (the "industrial area") showing the location of the former production facilities is shown in Figure 2-3.

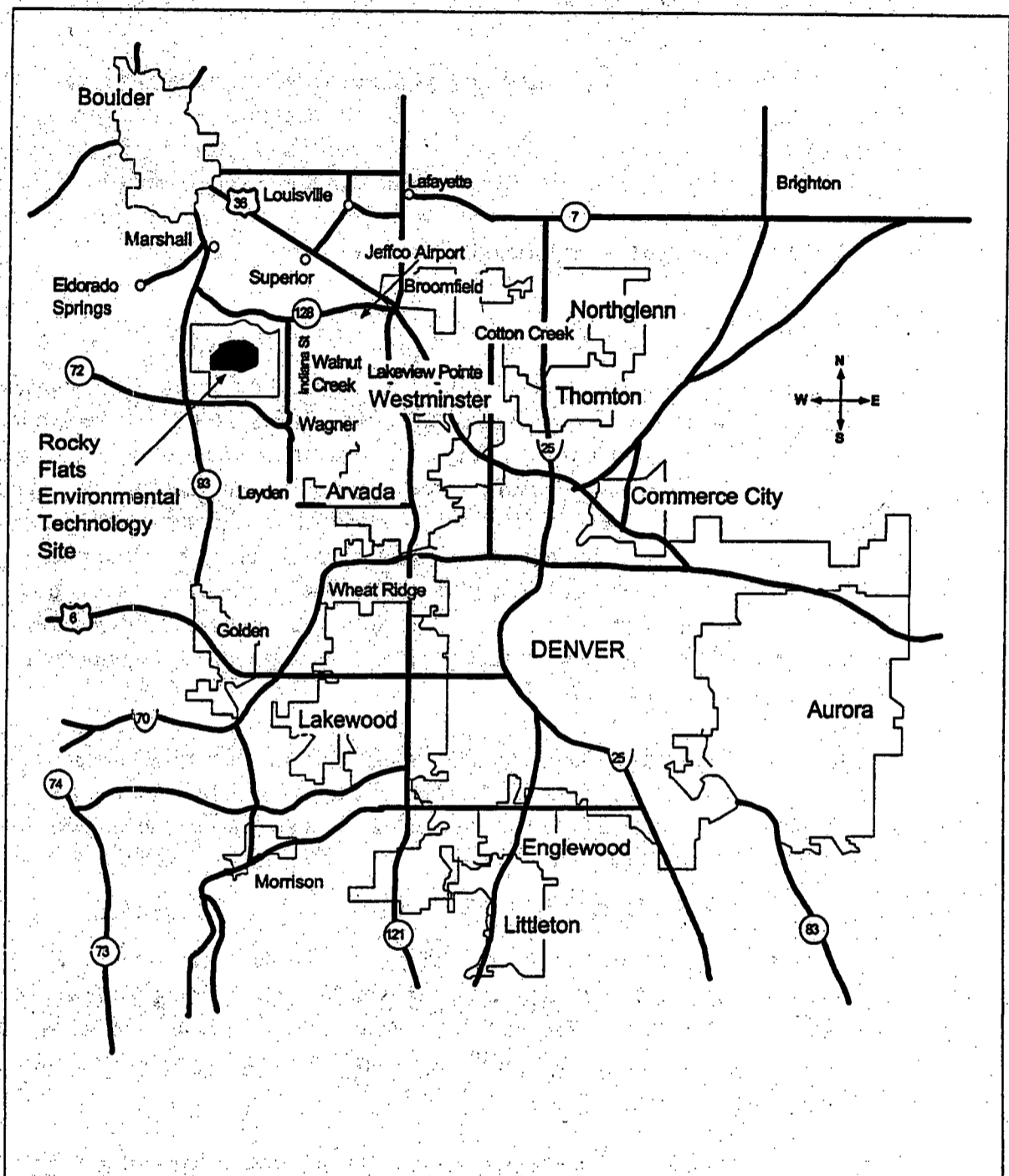


Figure 2-1. Area Map of the Rocky Flats Environmental Technology Site and Surrounding Communities

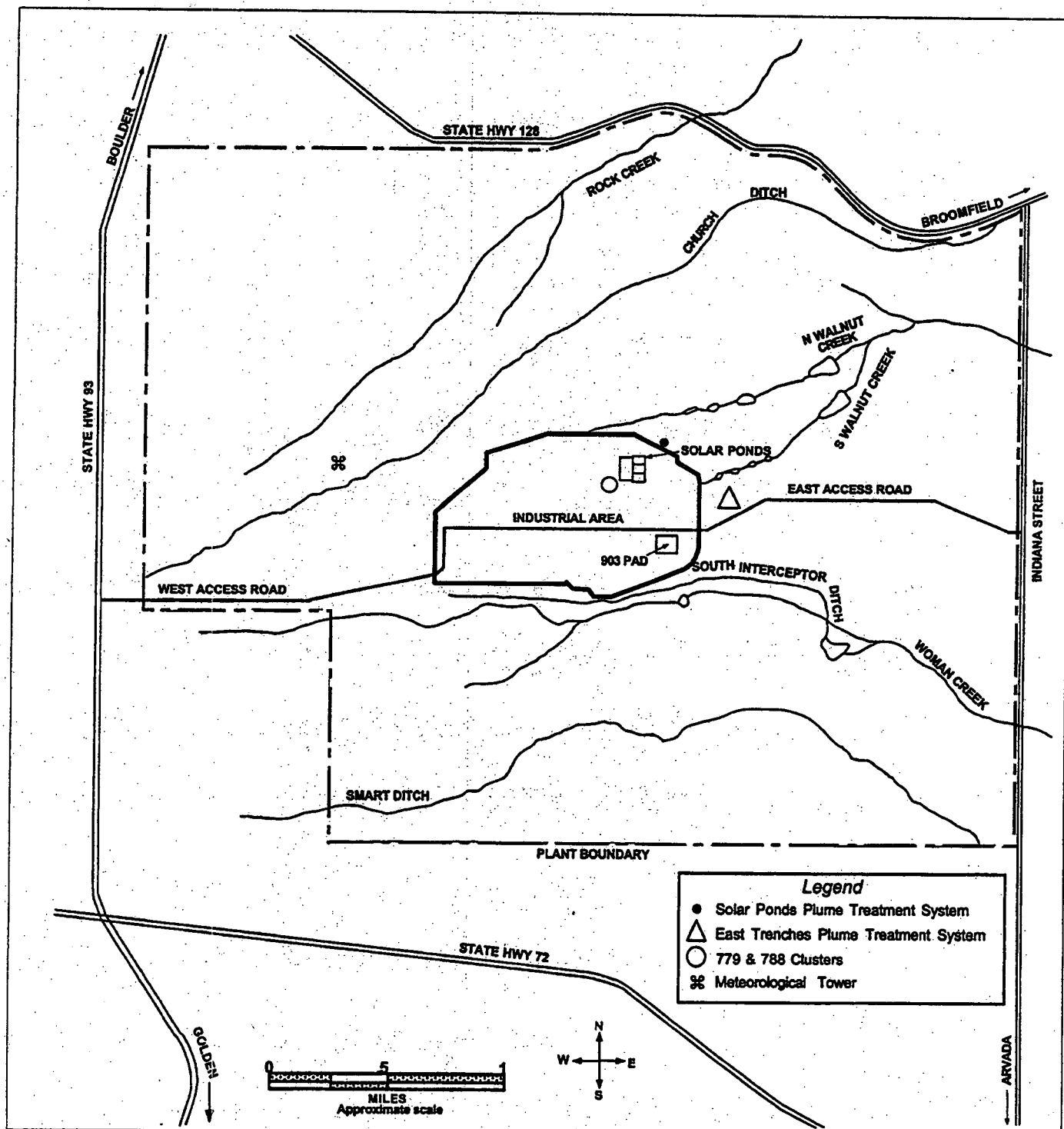


Figure 2-2. Rocky Flats Environmental Technology Site Location Map

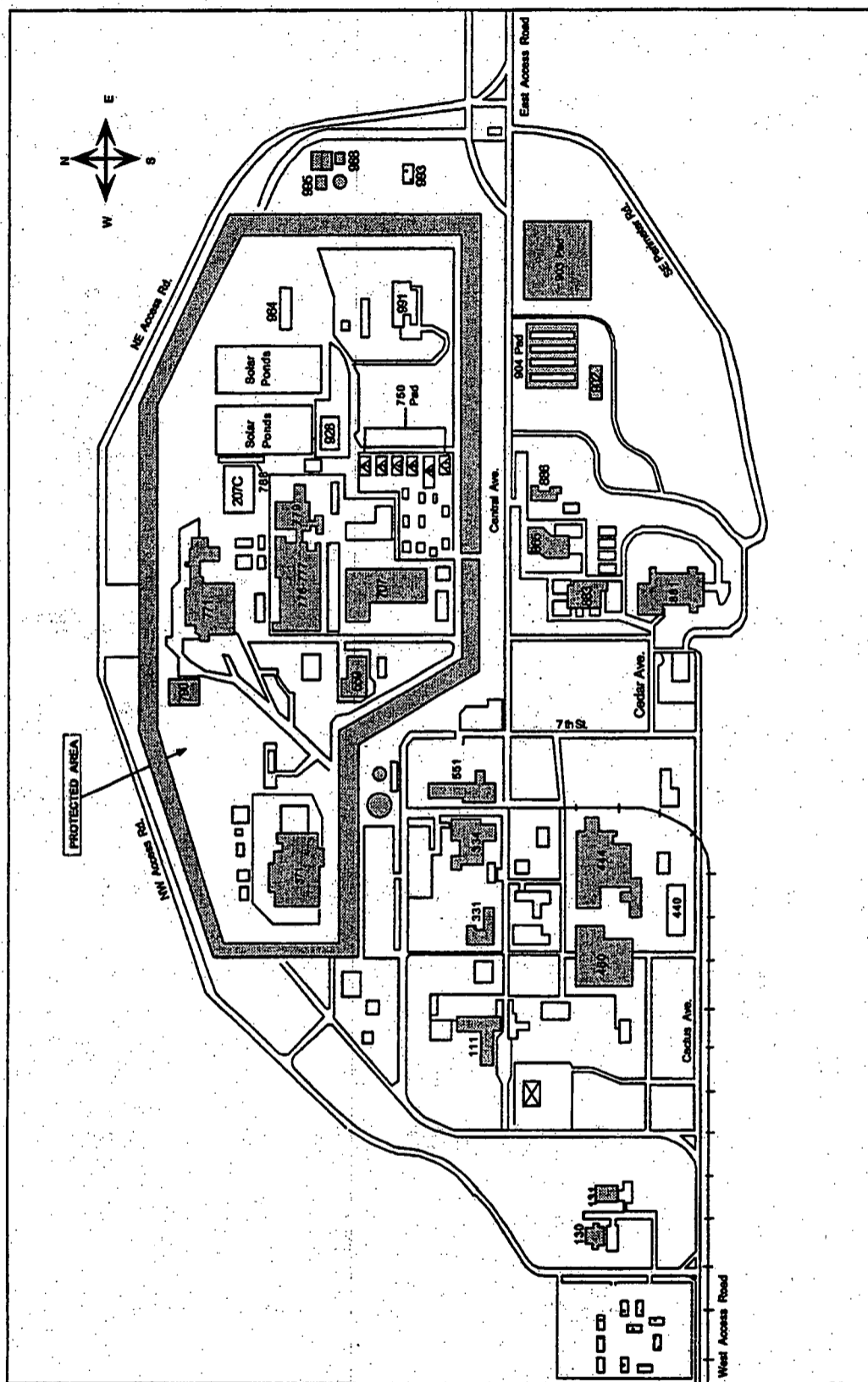


Figure 2-3. Central Portion of the Rocky Flats Environmental Technology Site (Industrial Area)

The central portion of the Site, which houses the former production facilities, can be roughly divided into halves. The Protected Area, generally located in the northern half of the central area (see Figure 2-3), historically housed plutonium processing operations. The rest of the industrial area housed uranium, beryllium, and stainless steel operations.

2.2 Radionuclide Air Emissions Source Description

Radioactive material handling at the Site is currently focused on material consolidation, cleanup, radioactive residue stabilization, waste processing, and analytical operations. Most of the radionuclide air emissions from the Site result from nonpoint (diffuse) sources, primarily mechanical and natural disturbances of contaminated soil and releases from handling, repackaging, and transferring solid and liquid waste materials in preparation for Site closure. Soil contamination was caused by past radioactive material spills and other releases. In addition, the soils on and around the Site contain small quantities of naturally occurring radionuclides.

Radioactive material processing can result in radionuclides becoming entrained in ventilation air (effluent) that is released through vents or stacks (point sources). However, because no routine nuclear weapons-related processing has occurred at the Site since 1989, most radionuclide point source emissions result from the resuspension of residual radioactive material in ventilation systems and from decontamination and deactivation activities taking place in process buildings.

Air exhausted from process buildings is cleaned prior to release by passing it through multiple stages of high efficiency particulate air (HEPA) filters. As a result, radionuclide point source emissions from the Site are very low.

2.2.1 Radioactive Materials Handling and Processing in Calendar Year 1999

In 1999, radionuclide emissions to air occurred from several activities that either disturbed resident contamination in buildings or in soil, or that processed or used radionuclide-containing substances. Appendix A lists radioactive materials associated with the Site. The list of radionuclides includes Pu-239/240, americium (Am)-241, U-233/234, U-235, U-238, and tritium. The Site also has some small quantities of beta- and gamma-emitting sealed sources and low activity analytical stock solutions, powders, and plated sources; emissions from these sources were negligible.

The major Site activities and sources that handled or processed radionuclides in calendar year 1999, with resulting radionuclide emissions, are described below.

Hold-up in Ducts

Radionuclide emissions were generated through disturbance of radionuclide-contaminated dust and other deposits on the surfaces of ventilation ducts exiting process areas. These materials were deposited on duct walls and, in rapidly decreasing amounts, on successive stages of HEPA filters during many years of weapons component production. Routine air movement and pressure changes in the ducts entrain a small amount of this contamination on an ongoing basis. In addition, decontamination and equipment removal or reconfiguration activities disturbed a portion of the hold-up in certain ducts in 1999, resulting in additional emissions to the atmosphere. Ducts containing hold-up were vented through multiple stages of HEPA filters.

Resident Contamination

In some process areas, contamination may be found on glovebox surfaces and floors, and, in limited cases, in the rooms themselves. This contamination has been surveyed and estimated using surface swipes in the areas. As with hold-up, resident contamination was emitted in 1999 due to routine exposure to ventilation air and due to active disturbance by project activities, particularly decontamination and equipment movement. Ducts venting areas with contamination were exhausted through HEPA filters.

Consolidation of Special Nuclear Material (SNM)

SNM is plutonium and enriched uranium contained in weapons components, metals, metal alloys, and oxides. Consolidation activities related to SNM continued in calendar year 1999 and included metal brushing, size reduction of metal, thermal stabilization of oxide, and packaging and interim storage of SNM. These consolidation activities are defined as follows:

- Metal brushing: Mechanical removal of metal oxide from metal surfaces.
- Size reduction: Reduction of material size by breaking, cutting, sawing, or pressing to accommodate storage container requirements.
- Thermal stabilization of oxide: Treatment of unstable forms of metal oxides in furnaces operating in the range of 800 to 1,200 degrees Celsius (°C) to remove moisture and to fully oxidize the metal to stable form.
- Packaging and storage: Placement of material in approved, inert atmosphere, storage containers, which in turn are placed in "storage vaults" or "vault-type rooms." Storage vaults are repositories of SNM materials that satisfy required safety and risk criteria.

Consolidation activities resulted in radionuclide emissions in 1999 through exposure of SNM to ventilation air, as well as through mechanical and thermal disturbance of SNM. Consolidation was performed in areas where ventilation air was exhausted through HEPA filters.

Waste Handling

Most of the low-level, low-level mixed, and TRU waste materials at the Site were generated during plutonium weapons component production and radionuclide recovery operations conducted prior to 1989. In 1999, some solid waste forms, including contaminated gloveboxes and duct work, were segregated and size reduced prior to packing for storage and disposal. Such activities disturbed the radioactive contamination in the waste, resulting in radioactive particles in the room air.

Radioactive wastes were handled (segregated, size reduced, and packaged) inside buildings or other structures. Venting the air through HEPA filters controlled emissions from these operations.

In addition to solid waste forms, liquid waste in tanks and pipes may also release radionuclides to the atmosphere, either through routine passive venting, or when liquid waste is exposed to the atmosphere when systems are drained or the materials treated. In addition to routine emissions from tank vents, liquid waste movement projects contributed to emissions during 1999. Where possible, these activities took place in areas that vented through HEPA filters.

Waste Storage

Packaged low-level, low-level mixed, and TRU wastes are commonly stored in drums at various locations on the Site. In 1999, drums were vented to prevent pressure buildup from hydrogen gas generated as a product of radiolytic activity affecting packaged materials. While hydrogen is routinely vented, radionuclide emissions would only occur from these drums if the inner packaging failed. To minimize emissions should the inner packaging fail, the drums were equipped with small filter cartridges that functioned like HEPA filters. For purposes of estimating emission potential for compliance with 40 CFR 61, Subpart H, the packaged materials inside these drums were considered sealed sources (in accordance with Appendix D to 40 CFR 61).

Waste Repackaging

Radionuclide emissions were generated in 1999 from waste characterization and repackaging activities that are ongoing at the Site in support of waste shipment operations. Waste shipment plans required the characterization and repackaging of various radionuclide-contaminated waste and residues in preparation for shipment and

final disposition to off-Site facilities. All of the waste repackaging activities that occurred in 1999 took place in areas that were vented through HEPA filters.

Remediation Projects

As cleanup of the Site continues, remediation activities also contribute to the resuspension of contaminated soils and debris. Remediation projects at the Site are performed in accordance with the Rocky Flats Cleanup Agreement (RFCA). RFCA is a negotiated, interagency agreement governing Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) cleanup activities at the Site. RFCA defines Tier I and Tier II action levels based on concentrations of various contaminants in the water or soil, where contamination above the higher Tier I action levels suggests cleanup may be necessary, while contamination above Tier II requires further evaluation.

In 1999, remediation activities at the Site included the East Trenches Plume Treatment System project and the Solar Ponds Plume Treatment System project, which required installation of water collection and treatment systems. Emissions from these activities were controlled using dust suppression techniques.

Building Cluster Demolition Projects

RFCA also governs Site demolition projects. RFCA requires that contaminated buildings be decontaminated and unneeded buildings demolished. In most cases, contaminated systems and materials are decontaminated and removed prior to demolition.

In 1999, the Building 788 Cluster, and parts of the Building 779 Cluster, were demolished. Contamination in the clusters was removed or fixed in place prior to demolition to prevent emission to the atmosphere or to water. Airborne emissions during demolition were controlled using water spray as a dust suppression technique.

Miscellaneous Point Sources

In late 1997, several laboratory operations were transferred from Buildings 881 and 123 to a new modular laboratory. The modular analytical laboratory continued operations in 1999, with low-level radionuclide emissions from the handling of contaminated media (such as filters).

Other miscellaneous point sources that were initiated in 1999 included low-level and low-level mixed waste repackaging operations in Tents 10 and 11 on the 904 Pad, and in Tent 5 on the 750 Pad. These operations are described in more detail in Section 2.2.2.

Miscellaneous Nonpoint Sources

Another contributor to Site radionuclide emissions in 1999 was the resuspension of contaminated soils. Contaminated soils were resuspended by wind erosion, vehicle traffic, and other mechanical soil disturbances not directly associated with specific remediation projects. Emissions generated by wind erosion were uncontrolled, while radionuclide emissions from vehicle traffic and mechanical disturbances were generally controlled using dust suppression techniques.

In addition to the resuspension of contaminated soils, the other miscellaneous nonpoint source that contributed to Site radionuclide emissions in 1999 was a drum crushing operation within the Protected Area that was initiated in 1996 and continued to operate through 1999. This operation created small amounts of radionuclide emissions by disturbing low levels of radiological contamination on the drum surfaces. This operation was described in the calendar year 1996 annual report (DOE, 1997b).

2.2.2 New Construction and Modifications in Calendar Year 1999

Fifteen new or modified activities that contributed to the Site air pathway dose are described below. (Emissions used in calculating the 1999 off-Site dose, as well as the location for each activity, are discussed in Sections 3.0 and 4.0 of this report.)

As part of the project evaluation process, the maximum annual (controlled) off-Site EDE that could result from each new or modified activity was calculated or otherwise estimated to determine whether approval and notification were required. Maximum potential radionuclide emissions were estimated using emission and control factors from Appendix D to 40 CFR 61, combined with information regarding radionuclide contaminant levels and material forms, radionuclide release mechanisms, and the radionuclide emission controls employed. In cases where HEPA filters were employed, credit was taken for a maximum of two stages, although up to five stages may actually have been employed. Emissions were modeled using the Clean Air Act Assessment Package-1988 (CAP88-PC), Version 1.0, and recent Site meteorological data to estimate annual EDEs at the most impacted off-Site residence and business locations. For emissions that were subsequently sampled and measured, the measured radionuclide concentrations were used to calculate the 1999 air pathway dose, as described in Sections 3.0 and 4.0 of this report.

The detailed data and calculations used to develop emission estimates and resulting dose projections are maintained in Site files. The project- or process-specific EDEs used in making regulatory applicability decisions regarding approval requirements are reported below.

The estimated EDE (see below) for each new construction or modification was less than 1% of the 10 mrem (0.1 mSv) standard, and construction approval and startup notification were unnecessary under 40 CFR 61.96.

Ash Residue Repackaging in Building 776: Prior to 1992, the primary mission of the Site was to produce plutonium components for nuclear weapons as part of the overall national defense program. The handling of plutonium and plutonium compounds during manufacturing and recovery operations produced a wide variety of contaminated by-products. Ash residues are one category of these by-products. The ash residues were repackaged to meet waste acceptance criteria for potential shipment to the Waste Isolation Pilot Plant (WIPP).

Ash residue drums were transferred to the advanced size-reduction facility (ASRF) in Building 776 where a visual and radiological inspection was performed. Each drum was moved to Glovebox J176, where the lids were removed and the entire drum contents were lifted into place. The drum contents were then sorted, sieved, and repackaged into other containers to ensure that maximum plutonium content and minimum fill height requirements were met. The cans were then placed in convenience cans, then into final Pipe Overpack Containers for shipment to WIPP.

Glovebox J176 in the ASRF exhausted through four stages of HEPA filters, through a vent that was continuously sampled for radionuclide emissions. The maximum annual (controlled) off-Site EDE resulting from the ash residue repackaging project was estimated to be 5.3×10^{-5} mrem (5.3×10^{-7} mSv). This dose calculation was based on the activity process rate and the total plutonium content of the ash residues, and on emission factors from 40 CFR 61, Appendix D.

Salt Residue Repackaging in Building 371: In 1999, salt residues were repackaged in Building 371. Small batches of the residue material were introduced into the Room 3602 glovebox system and transferred to workstations. Containers were emptied into a pan and materials were segregated, size reduced as necessary, and blended to meet safeguards-mandated plutonium content requirements. Blended material was then repackaged for off-Site disposition.

The gloveboxes in Room 3602 exhausted through four stages of HEPA filters, through a vent that was continuously sampled for radionuclide emissions. The off-Site EDE was calculated based on the known total plutonium and americium content in the materials and the process rate. The emission factors used were from Appendix D to 40 CFR 61, Subpart H. The maximum annual (controlled) off-Site EDE from this activity was estimated to be 3.1×10^{-4} mrem (3.1×10^{-6} mSv).

904 Pad, Tent 11 Repackaging of Waste Chemicals: In 1999, drums of legacy waste chemicals were repackaged in the Tent 11 permacon on the 904 Pad. The drums were evaluated, characterized, and repackaged for off-Site disposal, or returned to on-Site storage.

The permacon exhausted through two stages of HEPA filters. Dose calculations for this project were based on the conservative assumption that all drums were at the maximum concentration for low-level waste (100 nanocuries plutonium per gram waste), on the assumption that there would be 20 drums within the permacon open to the atmosphere at all times, and on emission factors from 40 CFR 61, Appendix D. The maximum annual (controlled) off-Site EDE for this project was estimated to be 7.5×10^{-5} mrem (7.5×10^{-7} mSv).

904 Pad, Tent 10 Repackaging of Low-level/Low-level Mixed Waste: In 1999, low-level/low-level, mixed waste was repackaged in the Tent 10 permacon on the 904 Pad. Noncompliant waste drums and boxes that did not meet the receiver site waste acceptance criteria or Department of Transportation regulations were transported to the Tent 10 permacon, characterized, sorted, and repackaged to bring them into compliance. The repackaged containers were then stored for eventual shipment to an approved off-Site disposal facility.

The permacon exhausted through two stages of HEPA filters. Dose calculations for this project were based on the conservative assumption that all waste forms were at the maximum concentration for low-level waste (100 nanocuries plutonium per gram waste), on the assumption that the process would operate at its maximum design rate, and on emission factors from 40 CFR 61, Appendix D. The maximum annual (controlled) off-Site EDE for this project was estimated to be 6.8×10^{-5} mrem (6.8×10^{-7} mSv).

Repackaging of Legacy/Orphan Wood Crates and Low-level Mixed Waste Sampling at the 750 Pad, Tent 5: In 1999, 32 containers of low-level mixed waste were sampled, and 157 wood crates were characterized and repackaged in the 750 Pad, Tent 5 permacon. The wood crates were relocated from outside locations to the Tent 5 permacon, where the contents were unpacked, segregated, sampled, and then repackaged in compliant containers and staged for eventual shipment to an approved off-Site disposal facility. The low-level waste containers were sampled in a soft-sided containment structure inside the Tent 5 permacon.

The permacon exhausted through two stages of HEPA filters. Dose calculations for the wood crate repackaging project were based on the conservative assumption that all waste forms were at the maximum concentration for low-level waste (100 nanocuries plutonium per gram waste), on the assumption that all 157 crates would be repacked in one year, and on emission factors from 40 CFR 61, Appendix D. Dose calculations for low-level waste sampling were based on the conservative assumption that all waste forms were at the

maximum concentration for low-level waste, on the assumption that two containers were open at all times during the sampling process, and on emission factors from 40 CFR 61, Appendix D. The maximum annual (controlled) off-Site EDE for this project was estimated to be 2.5×10^{-6} mrem (2.5×10^{-8} mSv).

Rinsing and Thermal Stabilization of Plutonium Chips and Fines in Building 707: Plutonium chips and fines were generated during SNM holdup removal and oil draining of metal machining equipment in Buildings 777 and 707. The chips and fines were immersed in oil and placed inside cans for interim storage. The cans containing chips and fines were transferred to Glovebox J-55 in Building 707. The chip and fines were placed into a perforated metal basket and degreased in a series of solvent baths. The chips were then transferred to Glovebox J-25 for thermal stabilization.

Gloveboxes J-55 and J-25 in Building 707 exhausted through four stages of HEPA filters, through a vent that was continuously sampled for radionuclide emissions. The maximum annual (controlled) off-Site EDE resulting from the plutonium chips and fines rinsing and thermal stabilization project was estimated to be 2.9×10^{-7} mrem (5.3×10^{-9} mSv). This dose calculation was based on the total quantity of plutonium chips and fines to be rinsed, and on emission factors from 40 CFR 61, Appendix D.

Plutonium Sizing in Building 707: In 1999, plutonium sizing was performed in Building 707. The plutonium parts were moved to Glovebox K-95 using the chainveyor system. They were sheared/cut to appropriate size and weight to feed the plutonium stabilization and packaging system (PuSPS) and the SNM program. Once the parts were cut to the appropriate size and weight, they were moved to Glovebox J-15 and packaged in the appropriate containers, then transferred for interim storage prior to entering the PuSPS or SNM programs for subsequent off-Site shipping.

Gloveboxes J-15 and K-95 in Building 707 exhausted through four stages of HEPA filters, through a vent that was continuously sampled for radionuclide emissions. The maximum annual (controlled) off-Site EDE resulting from the plutonium size-reduction process was estimated to be 1.0×10^{-4} mrem (1.0×10^{-6} mSv). This dose calculation was based on the total quantity of plutonium parts to be size reduced, on maximum process rates, and on emission factors from 40 CFR 61, Appendix D.

Removal of Process Piping in Building 771: The Building 771 process piping was drained and removed in 1999, as part of the Building 771 Cluster decommissioning project. Thirty-eight specific systems were identified, and the solutions drained, characterized, and dispositioned to a final state. Final dispositioning included solidification, treatment through the Building 371 caustic waste system, treatment through the Building 374 evaporator system, or treatment through the Building 771 hydroxide precipitation process. Once drained, the approximately 18,000 linear feet of

process piping was removed and packaged for shipment to its final storage/disposal location.

Building 771 exhausted through four stages of HEPA filters, through a vent that was continuously sampled for radionuclide emissions. The maximum annual (controlled) off-Site EDE resulting from the Building 771 process piping removal project was estimated to be 1.4×10^{-5} mrem (1.4×10^{-7} mSv). This dose calculation was based on the total quantity of piping to be removed, which was assumed to be contaminated with a solution at a concentration of 150 grams Pu-239/240 per liter, and on emission factors from 40 CFR 61, Appendix D.

Installation of a Sidewalk Between Buildings 561 and 564: In 1999, a sidewalk was installed between Building 561 and Building 564. The sidewalk was 60 feet long, 4 feet wide, and 6 inches deep. Radiological engineering concluded that americium levels in the soil were likely to be above the RFCA Tier II action level.

The EDE estimation used emission factors from 40 CFR 61, Appendix D, and was based on the volume of soil excavated and on estimated conservative isotopic contamination levels in the soil (Tier I action level for Am-241, and Tier II action levels for plutonium and uranium isotopes). The maximum annual off-Site EDE from the project was estimated to be 7.4×10^{-4} mrem (7.4×10^{-6} mSv).

Fiscal Year 1999 Well Abandonment and Replacement Program: In calendar year 1999, approximately 40 monitoring wells were installed at the Site. The wells were installed to support the following five projects: actinide migration evaluation; 903 Pad/Ryan's Pit plume characterization; industrial area plume treatment system characterization; Solar Ponds Plume Treatment System characterization; and decommissioning and demolition of Buildings 444, 771, and 886. The wells were installed using hollow stem auger and Geoprobe® technologies.

The EDE estimation used emission factors from 40 CFR 61, Appendix D, and was based on the volume of soil excavated and on conservative isotopic contamination levels in the soil. The maximum annual off-Site EDE from the project was estimated to be 1.9×10^{-5} mrem (1.9×10^{-7} mSv).

Solar Ponds Plume Treatment System: Historical operations at the Site resulted in the generation of liquid and solid waste containing radioactive and hazardous constituents that were managed in various waste processing units. The Solar Evaporation Ponds (SEPs), located in the northeastern portion of the Protected Area, were one of these units. The SEPs were operated primarily to store and evaporate radioactive process wastes and neutralize acidic process wastes from 1953 to 1986. Leakage from the SEPs has contaminated the shallow groundwater in the area. This is known as the Solar Ponds Plume (SPP).

A downgradient capture and treatment system, consisting of a collection trench 650 feet in length, 15 feet wide, and 25 feet deep, with a treatment section in the middle that is approximately 100 feet square, by 25 feet deep, was installed in 1999. The trench was filled with sand and backfilled with clean excavated soil. The treatment section was half filled with iron filings and then backfilled with uncontaminated excavated soil. Excavation of the trench was performed with a backhoe, and backfilling was performed with a front-end loader.

Dose calculations from excavation and backfilling activities were based on maximum concentrations of radionuclides in the soil, as derived from concentration maps in the SPP Interim Measures/Interim Remedial Action Environmental Assessment decision document, and the volume of soil excavated and backfilled. Emission factors from Appendix D to 40 CFR 61 and an EPA reference document (EPA, 1995) were used in the emission calculations. While water spray was used to control dust, this control factor was not included in the emission calculations. The maximum annual off-Site EDE from these activities was estimated to be 2.2×10^{-3} mrem (2.2×10^{-5} mSv).

East Trenches Plume Treatment System: The East Trenches Plume is located north of Central Avenue, and east of the East Perimeter Road. The plume contains chlorinated organic compound contamination in excess of Tier II concentrations defined in RFCA. Most of the volatile organic compound (VOC) contamination is believed to be derived from the East Trenches area, with a component also derived from VOC contamination at the 903 Pad.

In 1999, a downgradient capture and treatment system was installed near Walnut Creek to capture the contaminated groundwater, to the extent practical, and to minimize contaminant impacts to surface water. The system consisted of a collection trench approximately 1,100 feet long, 20 feet wide, and 25 feet deep; treatment tanks containing iron filings in an area 100 feet square and 20 feet deep; and a connecting corridor between the trench and tanks 20 feet long and 15 feet deep. The trench was filled with sand and backfilled with uncontaminated excavated soil.

Dose calculations from excavation and backfilling activities were based on maximum concentrations of radionuclides measured from soil samples and on the volume of soil excavated and backfilled. Emission factors from Appendix D to 40 CFR 61 and an EPA reference document (EPA, 1995) were used in the emission calculations. While water spray was used to control dust, this control factor was not included in the emission calculations. The maximum annual off-Site EDE from these activities was estimated to be 6.9×10^{-3} mrem (6.9×10^{-5} mSv).

Building 779 Cluster Decontamination and Demolition: Building 779 Cluster demolition was initiated in 1999. Plenum Building 729 was demolished in 1999, and the

remaining buildings in the cluster were decontaminated and readied for demolition in calendar year 2000. Radionuclide emissions were not calculated but were considered negligible (well below the 0.1 mrem threshold) because decontamination was performed within intact building shells and air emissions were exhausted through multiple banks of HEPA filters. Also, buildings surfaces were decontaminated to unrestricted release criteria levels prior to demolition.

Building 788 Cluster and Clarifier Tank Demolition: The Building 788 Cluster and associated clarifier tank were demolished in 1999. The interior surfaces of Building 788 and the clarifier tank were decontaminated and then both structures were demolished. The clarifier tank was dismantled using shears, nibblers, and saws.

The off-Site EDE from the Building 788 Cluster and clarifier tank demolition was calculated based on the maximum contamination levels found in each building or tank during characterization surveys prior to decontamination and demolition, and on radionuclide emission factors from Appendix D to 40 CFR 61. Total areas of structures to be demolished were assumed to be contaminated at the maximum levels found in the characterization surveys. The maximum annual off-Site EDE for this project was estimated to be 2.7×10^{-4} mrem (2.7×10^{-6} mSv).

Building 886 Tank Removal: In 1999, pipes, pumps, and tanks were removed from Building 886 in preparation for closure. The project included cutting a hole in the roof of Building 886 and removing 10 tanks from Room 103 with a crane. A weatherproof shoebox enclosure was constructed around the opening to allow for future use of the opening for removal of other equipment.

The off-Site EDE from the Building 886 tank removal was calculated based on conservative contamination levels from surveys performed on the ceiling surface area, on maximum allowable air concentration levels, and on radionuclide emission factors from Appendix D to 40 CFR 61. The maximum annual off-Site EDE for this project was estimated to be 2.0×10^{-10} mrem (2.0×10^{-12} mSv).

3.0 AIR EMISSIONS DATA

This section discusses and quantifies radionuclide emissions from the Site for calendar year 1999. The stacks, vents, and other points where radioactive materials were released to the atmosphere are described, and the effluent controls employed by the Site to minimize emissions are discussed.

3.1 Emission Determination Process

The emission data presented in this section represent an estimate of total Site radionuclide air emissions in calendar year 1999. The radionuclide emissions presented in this section were used in the dispersion modeling analysis that was prepared for comparison with the primary compliance demonstration method sampling results (described in Section 4.1 of this report).

In most cases, air effluent exiting buildings through stacks or vents was continuously sampled and radionuclide emissions measured. Where such data were available, the measured emissions were used in the modeling analysis. In other cases, emissions from activities that generated airborne radionuclides were not measured. For these activities, emissions were estimated based on project- or process-specific information, combined with emission factors from various sources.

As described in Section 2.2.2, expected radionuclide emissions must be estimated for proposed new or modified sources of radionuclide air emissions to determine compliance requirements and to evaluate the need for additional controls. For projects or processes whose emissions were not subsequently measured, this initial emission estimate was used for the modeling analysis, as long as the project or process was conducted consistent with the assumptions on which the initial emission estimate was based.

Where emissions reported in this section were estimated, rather than directly measured, the emission estimates were based on:

- The radionuclide content of materials handled or processed;
- The form of the radioactive material (gas, liquid, solid, or particulate);
- The mechanisms by which radionuclides were released to the atmosphere;
- The time over which the activities that released radionuclides occurred or the time that the radioactive material was exposed to the atmosphere;

- The control measures employed to reduce radionuclide emissions (a maximum of two stages of HEPA filters were credited, even if additional stages were actually employed); and
- Process- or activity-specific emission factors.

Emission factors were derived from several sources. Radionuclide emission factors listed in Appendix D to 40 CFR 61 were used to calculate emissions due to exposure of radioactive material to the atmosphere during processing or handling. Additional emissions resulting from the release of radionuclide-contaminated particles through handling or processing soil and debris were based on emission factors in EPA's *Compilation of Air Pollutant Emission Factors* (EPA, 1995). Where appropriate, emission data from a DOE publication, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities* (DOE, 1994), were also used. The appropriate emission factors were combined with project- or process-specific information to yield estimated radionuclide emissions.

In addition to the emission estimates calculated for specific projects or processes, an ongoing source of radionuclide emissions from the Site is the resuspension of contaminated surface soils by wind erosion. Emissions from this source were estimated by combining information regarding Site-wide surface soil concentrations of radionuclide contaminants with a Site-specific soil resuspension factor. The development of the Site-specific soil resuspension factor used in emission calculations was discussed in detail in a previous annual report (DOE, 1996).

Historical surface soil radionuclide concentration data from a Site-specific soil sampling database were used to develop a set of radionuclide concentration isopleths spanning the entire Site. New plutonium and americium soil samples were added to the database in 1999. The soil resuspension emissions for 1999 reflect information based on plutonium and americium concentration isopleths that were updated in 1999 and uranium concentration isopleths that were updated in 1998.

3.2 Point Sources

Radionuclide emissions released through stacks and vents are termed "point" sources. In 1999, radionuclide point sources at the Site included measured releases from stacks and vents in the industrial area, as well as several sources where emissions were calculated rather than measured.

Point source emissions for calendar year 1999 and the control technology used on each point source are described in this section.

3.2.1 Measured Point Source Emissions

During 1999, radionuclide emissions were collected and measured at two types of point sources: significant release points and insignificant release points. Significant release points are those that have the potential to discharge radionuclides into the air in quantities that would result in an annual EDE to the public greater than 1% of the 10 mrem standard, based on uncontrolled emissions (without considering HEPA filtration). Insignificant release points are those that have the potential to discharge radionuclides in lesser quantities. Significant release points must be continuously monitored or sampled, while insignificant release points require periodic confirmatory measurements to verify low emissions (40 CFR 61.93).

Point source emissions are measured at the Site with a sampling system that continuously draws a portion of the duct or vent airstream through a filter. Radioactive particles collect on the filters, which were exchanged weekly at the significant sampling locations and monthly at the insignificant locations in 1999. Following collection, the filters were screened for long-lived alpha and beta radiation to check for elevated radionuclide emissions.

Following alpha/beta screening, the samples were composited by location and analyzed for plutonium, americium, and uranium isotopes. All radionuclides that could contribute greater than 10% of the potential EDE for a release point were measured. Monthly composites were analyzed for each significant location. A composite of all of the filters collected in 1999 was analyzed for each insignificant location.

Tritium (H-3), which is emitted as a gas, is also sampled continuously at some locations. Tritium is collected by bubbling the duct or vent airstream through purified water. Tritium samples were analyzed as they were collected, three times a week.

Due to the complexity of the building ventilation systems at the Site, the number of sampling points used is not a one-to-one match with the number of release or emission points. In most cases, the effluent streams that are sampled correspond to a single release point. At some locations, however, the sampling location monitors an effluent stream that is released through multiple stacks or vents.

In 1999, particulate samples were collected at 49 routine sampling locations representing 58 release points. Of the 49 routine sampling locations, 19 were identified as significant point source locations and 30 were insignificant locations.

During 1999, several changes in point source emission measurements took place. Due to changes in activities in Building 440, sampling was initiated at that location in March 1999. Sampling in the Building 779 Cluster ceased, as decontamination and demolition readiness activities were completed. Finally, the Site transitioned from the use of multi-point effluent samplers to confirm low emissions at insignificant release points to using

RAAMP (ambient air) samplers to confirm low emissions. This effort was part of the alternative compliance demonstration method discussed in Section 4.1 of this report. Multi-point effluent sampling was discontinued in 1999 at all insignificant locations except in Buildings 776 and 374. Sampling was continued in these buildings for reasons unassociated with 40 CFR 61, Subpart H requirements. Appendix B lists the effluent release points that were sampled for part or all of 1999.

Measured 1999 emissions of plutonium, americium, and uranium are shown in Table 3-1. Four emission points were also sampled for tritium in 1999. In response to a re-evaluation of tritium emissions potential in Building 776, tritium sampling at three of the four locations was discontinued in July 1999; those locations are identified in Table 3-1.

In calendar year 1997, 18 particulate sampling locations were upgraded from multi-point sampling systems to single-point shrouded probe sampling systems, as required by a 1994 agreement between DOE and EPA (Brockman, 1995). Single-point shrouded probe sampling systems were also installed at locations 371-N01, 371-N02, and 371-SSS, and have been operated concurrently with the pre-existing multi-point sampling systems. Because the airflow patterns within the ducts in Building 371 did not produce uniform mixing, the data from the shrouded probe samplers were not included in Table 3-1; instead the multi-point sampling system data were used for this report.

In addition to routine measurements, special air sampling was performed in three locations within Building 779 for the first four months of 1999. The special samplers measured radioactivity in room air that was subsequently exhausted through two stages of HEPA filters. Emissions of plutonium, americium, and uranium were calculated based on this information, rather than directly measured, and are presented in Section 3.2.2.

Appendix C shows 1999 measured point source emissions data that would normally be contained in DOE's Effluent Information System (EIS)/Off-Site Discharge Information System (ODIS). DOE did not publish an EIS/ODIS report for 1999.

3.2.2 Calculated Point Source Emissions

During 1999, several point sources operated at the Site that did not trigger continuous sampling requirements because they had low emission potential or were of short duration. These sources included emissions from low-level and low-level mixed waste repackaging operations in Tents 10 and 11 on the 904 Pad and in Tent 5 on the 750 Pad, which were described in Section 2.2.2. Also, emissions from process waste tank vents in Building 776 and Thermo NUtech modular analytical laboratory activities exhausted to release points that did not trigger continuous sampling requirements. Low-level tritium emissions from Building 790 and Thermo NUtech were also calculated for 1999.

**Table 3-1. Measured Point Source Radionuclide Emissions for
Calendar Year 1999**

Building/ Location ^a	Isotope Emissions (Ci/yr) ^{b,c,d}					
	Pu-239/240	Am-241	U-233/234	U-235	U-238	H-3
Significant Release Points						
371-N01	6.1E-09	3.2E-09	1.5E-08	2.9E-09	9.1E-09	--
371-N02	1.6E-08	3.0E-09	1.1E-08	4.0E-09	9.9E-09	--
371-SSS	3.5E-09	8.4E-10	4.7E-09	7.7E-10	3.5E-09	--
374-MAI ^e	3.2E-09	3.0E-09	1.3E-08	3.7E-09	1.2E-08	--
440-101 ^{e,f}	1.8E-10	2.8E-10	9.2E-10	6.3E-10	1.7E-09	--
559-561 ^e	5.6E-09	5.7E-09	1.5E-08	6.1E-09	2.1E-08	--
707-101 ^e	7.6E-11	5.1E-11	2.5E-10	7.4E-11	1.9E-10	--
707-102 ^e	2.8E-10	1.7E-10	6.6E-10	3.5E-10	5.1E-10	--
707-105 ^e	2.1E-10	3.8E-10	4.2E-09	1.0E-09	2.9E-09	--
707-106 ^e	7.4E-10	4.0E-10	1.1E-09	6.2E-10	8.5E-10	--
707-107 ^e	2.5E-08	4.3E-09	1.4E-08	2.8E-09	1.2E-08	--
707-108 ^e	1.2E-09	8.8E-10	2.9E-09	1.7E-09	3.0E-09	--
771-MAI ^e	2.0E-08	2.2E-08	1.3E-07	2.7E-08	8.4E-08	--
774-202 ^e	6.6E-10	5.6E-10	5.1E-09	8.6E-10	3.5E-09	--
776-201 ^e	2.2E-11	5.8E-11	2.5E-10	8.8E-11	1.6E-10	--
776-204 ^e	2.9E-09	1.4E-09	2.6E-09	2.2E-09	4.8E-09	--
776-205 ^{e,g}	1.3E-09	2.0E-09	6.8E-09	2.8E-09	6.6E-09	--
776-205T ^h	--	--	--	--	--	1.7E-04
776-206T	--	--	--	--	--	8.5E-04
779-729 ⁱ	1.4E-10	8.7E-11	2.3E-11	5.1E-11	3.2E-11	--
779-782 ⁱ	4.0E-09	1.9E-09	1.8E-08	2.1E-09	1.3E-08	--
Insignificant Release Points						
374-SPD	1.8E-09	2.3E-09	< 0	< 0	1.8E-10	--
444-DO5 ⁱ	8.3E-11	< 0	< 0	3.5E-10	< 0	--
444-MAI ⁱ	< 0	< 0	< 0	< 0	< 0	--
447-MAI ⁱ	< 0	< 0	< 0	< 0	< 0	--
707-R21A/B ⁱ	3.3E-10	< 0	< 0	< 0	< 0	--
707-R22A/B ⁱ	5.9E-09	1.0E-09	< 0	< 0	3.1E-10	--
707-R23A/B ⁱ	2.8E-09	9.6E-10	5.1E-10	< 0	2.8E-10	--
707-R24A/B ⁱ	1.2E-10	< 0	< 0	< 0	2.3E-09	--
707-R25A/B ⁱ	3.6E-10	< 0	< 0	< 0	< 0	--
707-R26A/B ⁱ	5.7E-10	< 0	< 0	3.7E-10	< 0	--
707-R27A/B ⁱ	< 0	< 0	< 0	< 0	< 0	--
707-R45A/B ⁱ	7.6E-10	< 0	< 0	< 0	< 0	--
707-R46A/B ^h	7.0E-10	< 0	< 0	< 0	< 0	--
771-CMA ⁱ	1.2E-08	3.1E-10	< 0	< 0	< 0	--
771-CRM ⁱ	6.9E-10	2.2E-09	8.1E-10	2.0E-10	< 0	--
776-202	4.4E-10	< 0	< 0	7.4E-11	< 0	--
776-250 ^h	4.0E-09	< 0	1.6E-08	< 0	< 0	5.2E-04
776-251 ^h	3.5E-10	< 0	< 0	< 0	1.3E-09	2.8E-04
776-252	6.2E-10	2.1E-10	< 0	< 0	< 0	--
779-404 ⁱ	4.9E-09	4.4E-09	1.1E-09	1.0E-09	3.8E-09	--

Table 3-1. (Continued)

Building/ Location ^a	Isotope Emissions (Ci/yr) ^{b,c,d}					
	Pu-239/240	Am-241	U-233/234	U-235	U-238	H-3
Insignificant Release Points (continued)						
865-EEE ⁱ	1.7E-10	< 0	< 0	< 0	< 0	--
865-WWW ⁱ	7.0E-10	< 0	< 0	2.6E-10	< 0	--
881-MA1 ⁱ	4.0E-10	< 0	< 0	< 0	< 0	--
881-MA2 ⁱ	1.5E-09	< 0	< 0	< 0	< 0	--
881-MA3 ⁱ	1.8E-09	3.0E-10	< 0	< 0	< 0	--
881-MA4 ⁱ	< 0	6.3E-10	< 0	< 0	< 0	--
883-AAA ⁱ	1.7E-09	< 0	< 0	< 0	< 0	--
883-BBB ⁱ	6.6E-10	< 0	< 0	< 0	< 0	--
883-CCC ⁱ	3.8E-10	< 0	< 0	5.4E-11	< 0	--
886-875 ⁱ	2.8E-10	6.5E-10	1.5E-09	2.9E-10	1.1E-09	--

^a The first number in this column designates the building cluster, the second set of characters designates the specific duct(s) or vent(s). The location of each release point is shown in Figure 4-3 of this report.

^b Values were corrected for filter blanks.

^c All measured point sources were controlled by HEPA filters with a tested control efficiency of at least 99.97 percent.

^d All isotopes that could contribute greater than 10% of the potential EDE for a release point were measured. Isotopes not analyzed are shown as "--".

^e Shrouded probe data were used.

^f Release point 440-101 became active in March 1999.

^g Release points 776-205, -206, and -207 were combined through a mixing plenum and were sampled with one shrouded probe identified as 776-205.

^h Tritium sampling was discontinued on July 30, 1999.

ⁱ Release point became inactive in 1999; see Appendix B for more information.

Notes:

Am = Americium
 Ci/yr = Curies per year, 1 Ci = 3.7×10^{10} Becquerel (Bq)
 E# = $\times 10^{\#}$
 EDE = Effective dose equivalent
 HEPA = High efficiency particulate air
 H-3 = Tritium
 Pu = Plutonium
 U = Uranium
 -- = Not analyzed

Finally, radionuclide emissions from glovebox removal in Building 779, while measured, required additional calculations to estimate the actual emissions. Calendar year 1999 emissions from these point sources and the methods used to minimize emissions are described below.

Emissions were calculated for these insignificant release points as described in Section 3.1. Table 3-2 shows calculated point source emission estimates for calendar year 1999.

904 Pad, Tent 11 Repackaging of Waste Chemicals: In 1999, drums of waste chemicals at the Site were repackaged in the Tent 11 permacon on the 904 Pad. The drums were evaluated, characterized, and repackaged for off-Site disposal, or returned to on-Site storage.

The permacon exhausted through two stages of HEPA filters. Emission estimates for this project were based on the conservative assumption that all drums were at the maximum concentration for low-level waste (100 nanocuries plutonium per gram waste), and on the assumption that there would be 20 drums within the permacon open to the atmosphere at all times.

904 Pad, Tent 10 Repackaging of Low-level/Low-level Mixed Waste: In 1999, low-level/low-level mixed waste was repackaged in the Tent 10 permacon on the 904 Pad. Noncompliant waste drums and boxes that did not meet the receiver site waste acceptance criteria or Department of Transportation regulations were transported to the Tent 10 permacon, characterized, sorted, and repackaged to bring them into compliance. The repackaged containers were then stored for eventual shipment to an approved off-Site disposal facility.

The permacon exhausted through two stages of HEPA filters. Emission estimates for this project were based on the conservative assumption that all waste forms were at the maximum concentration for low-level waste (100 nanocuries plutonium per gram waste), and on the assumption that the process would operate at its maximum design rate.

Repackaging of Legacy/Orphan Wood Crates and Low-level Mixed Waste Sampling at the 750 Pad, Tent 5: In 1999, 32 containers of low-level mixed waste were sampled, and 157 wood crates were characterized and repackaged in the 750 Pad, Tent 5 permacon. The wood crates were relocated from outside locations to the Tent 5 permacon, where the contents were unpacked, segregated, sampled, and then repackaged in compliant containers and staged for eventual shipment to an approved off-Site disposal facility. The low-level waste containers were sampled in a soft-sided containment structure inside the Tent 5 permacon.

**Table 3-2. Calculated Point Source Radionuclide Emissions for
Calendar Year 1999**

Activity or Building	Isotope Emissions (Ci/yr) ^a					
	Pu-239/ 240	Am-241	U-233/234	U-235	U-238	H-3
904 Pad, Tent 11 Waste Chemical Repackaging and Tent 10 Low-level/Low-level Mixed Waste Repackaging ^b	3.5E-04	4.4E-05	--	--	--	--
Legacy/Orphan Wood Crates Repackaging and Low-level Mixed Waste Sampling at 750 Pad, Tent 5 ^b	5.8E-05	7.3E-06	--	--	--	--
Glovebox Removal in Building 779, Plenum 405 ^b	3.1E-10	1.0E-10	1.8E-12	2.6E-13	3.0E-12	--
Thermo NUtech Modular Analytical Laboratory ^c	--	--	--	--	--	1.3E-06
Building 776 Process Waste Tanks ^b	3.2E-08	4.0E-06	--	--	--	--
Building 790 ^d	--	--	--	--	--	2.9E-06

^a Emissions of all isotopes that could contribute greater than 10% of the potential EDE for a release point were estimated. Isotopes for which emissions were not estimated are shown as "--". The locations of the release points listed are shown in Figure 4-3 of this report.

^b HEPA filtration used with a control efficiency of at least 99.97 percent.

^c Assumed uncontrolled.

^d Uncontrolled for tritium.

Notes:

Am = Americium
 Ci/yr = Curies per year, 1 Ci = 3.7×10^{10} Becquerel (Bq)
 E# = $\times 10^{\#}$
 EDE = Effective dose equivalent
 HEPA = High efficiency particulate air
 H-3 = Tritium
 Pu = Plutonium
 U = Uranium
 -- = Not estimated/negligible

The permacon exhausted through two stages of HEPA filters. Emission estimates for the wood crate repackaging project were based on the conservative assumption that all waste forms were at the maximum concentration for low-level waste (100 nanocuries plutonium per gram waste), and on the assumption that all 157 crates would be repackaged in one year. Emission estimates from the low-level waste sampling were based on the conservative assumption that all waste forms were at the maximum concentration for low-level waste, and on the assumption that two containers were open at all times during the sampling process.

Glovebox Removal in Building 779: Ongoing activities in Building 779 that continued into calendar year 1999 involved the removal and size reduction of gloveboxes, B-boxes, and hoods in areas venting to plenums 404 and 405. Effluent streams were exhausted through two stages of HEPA filters. Activities that had the potential to emit radionuclides through plenum 405 were monitored by air sampling heads located in the rooms where the activities occurred. Samples from these room air sampling heads were collected weekly, composited, and then analyzed monthly. To estimate the radionuclide emissions, the removal efficiency of the two stages of HEPA filters, the total plenum system flow rate, and the measured room air concentrations were used. The calculated emissions of plutonium, americium, and uranium for 1999 are shown in Table 3-2.

Thermo NUtech Modular Analytical Laboratory: As a result of tritium standards preparation and use, tritium emissions were calculated for 1999. All the tritium contained in the standard solutions used in 1999 was assumed to have been emitted, as no emission controls were employed.

Building 776 Process Waste Tanks: Building 776 has process waste tanks in Room 127 that vent (passive vent) to the atmosphere through one HEPA filter. Emissions for 1999 were calculated based on the conservative assumption that all of the waste material was contaminated at the highest recorded plutonium concentration based on historical sampling data.

Building 790: As a result of instrumentation calibration in Building 790 (Health Physics Instrumentation Facility), low-level tritium emissions were calculated for 1999. The tritium emissions were based on monthly reports that documented the total number and the tritium activities of the calibration solutions used. The total tritium contained in 1999 calibration solutions was assumed to have been emitted. No radionuclide emission controls were employed.

3.2.3 Control Technology for Point Sources

HEPA filters are used to control radioactive particulate emissions from air effluent systems. All of the point source locations listed in Table 3-1 used HEPA filtration in

1999. Air effluent from plutonium processing areas was cleaned by a minimum of four stages of HEPA filters. Air effluent from areas that processed plutonium-contaminated waste was typically cleaned by four stages of HEPA filters. Air effluent from uranium processing areas was generally cleaned by a minimum of two stages of HEPA filters. HEPA filters are bench tested prior to installation in the buildings to ensure that they would meet a minimum filter efficiency of 99.97% (Novick, et al., 1985). Filter assemblies are tested again for leaks following installation.

Waste repackaging activities at the 904 Pad, Tents 10 and 11, and the 750 Pad, Tent 5, were controlled by two stages of HEPA filters. Building 776 process waste tank closure activities were controlled using at least single-stage HEPA filtration. Glovebox removal in Building 779 was controlled by two stages of HEPA filters. Thermo NUtech activities were generally uncontrolled, except for the waste storage area, which vents through a HEPA filter. The tritium emissions shown in Tables 3-1 and 3-2 were uncontrolled (HEPA filters do not control tritium, which is released as a gas).

3.3 Nonpoint Sources

Radionuclide emissions that are not released through specific stacks or vents are termed "nonpoint" (or diffuse) sources. In calendar year 1999, nonpoint sources of radionuclide emissions at the Site included resuspension of contaminated soils by wind erosion and by mechanical disturbance due to excavation, handling, and vehicle traffic. Mechanical disturbance of contaminated soils was associated with:

- Sidewalk installation between Buildings 561 and 564;
- The Well Abandonment and Replacement Program;
- The East Trenches Plume Treatment System project; and
- The Solar Ponds Plume Treatment System project;

Finally, 1999 nonpoint sources also included the Building 788 Cluster and clarifier tank demolition project, the Building 779 Cluster decontamination and demolition project, the Building 886 tank removal project, and the ongoing drum crushing operation in the Protected Area. Emissions were assumed to be negligible for the Building 779 Cluster decontamination and demolition project, as discussed in Section 3.3.1.

Calendar year 1999 emissions from nonpoint sources and the methods used to minimize emissions are described below. The projects and operations that generated nonpoint air emissions of radionuclides in 1999 are described in greater detail in Sections 2.2.1 and 2.2.2 of this report. Table 3-3 summarizes emissions from nonpoint sources for calendar year 1999.

**Table 3-3. Nonpoint Source Radionuclide Emissions
for Calendar Year 1999**

Isopleth or Project ^a	Isotope Emissions (Ci/yr) ^b				
	Pu-239/240	Am-241	U-233/234	U-235	U-238
Isopleth 1	9.2E-06	2.0E-06	2.2E-07	5.3E-09	5.5E-10
Isopleth 2	5.6E-06	1.8E-06	--	7.9E-11	4.0E-09
Isopleth 3	7.1E-06	1.6E-07	--	1.7E-08	1.4E-07
Isopleth 4	7.4E-08	6.6E-07	--	7.1E-10	1.1E-09
Isopleth 5	1.3E-09	1.7E-06	--	1.5E-09	--
Isopleth 6	5.4E-06	1.7E-06	--	7.2E-09	--
Isopleth 7	1.5E-09	7.0E-07	--	--	--
Isopleth 8	4.7E-09	1.4E-07	--	--	--
Isopleth 9	4.7E-08	7.5E-07	--	--	--
Isopleth 10	3.6E-09	4.0E-07	--	--	--
Isopleth 11	3.3E-09	2.1E-06	--	--	--
Isopleth 12	5.2E-08	1.1E-06	--	--	--
Isopleth 13	3.1E-07	1.1E-07	--	--	--
Isopleth 14	1.2E-11	8.9E-09	--	--	--
Isopleth 15	3.4E-06	1.1E-08	--	--	--
Isopleth 16	9.8E-06	8.3E-11	--	--	--
Isopleth 17	3.9E-06	4.5E-07	--	--	--
Isopleth 18	3.7E-10	3.2E-09	--	--	--
Isopleth 19	3.1E-09	5.7E-07	--	--	--
Isopleth 20	8.6E-10	1.1E-10	--	--	--
Isopleth 21	6.1E-10	3.0E-11	--	--	--
Isopleth 22	1.7E-07	1.0E-09	--	--	--
Isopleth 23	1.1E-06	4.2E-09	--	--	--
Isopleth 24	3.3E-10	1.4E-08	--	--	--
Isopleth 25	6.6E-09	1.5E-10	--	--	--
Isopleth 26	8.0E-10	2.9E-09	--	--	--
Isopleth 27	2.6E-11	4.0E-14	--	--	--
Isopleth 28	3.8E-09	6.2E-10	--	--	--
Isopleth 29	4.4E-11	2.5E-10	--	--	--
Isopleth 30	3.4E-09	3.9E-08	--	--	--
Isopleth 31	1.7E-09	1.9E-12	--	--	--
Isopleth 32	3.5E-10	7.8E-11	--	--	--
Isopleth 33	6.8E-09	6.8E-07	--	--	--
Isopleth 34	4.5E-09	--	--	--	--
Isopleth 35	1.5E-10	--	--	--	--
Isopleth 36	1.9E-10	--	--	--	--
Isopleth 37	1.7E-09	--	--	--	--
Isopleth 38	1.7E-11	--	--	--	--
Isopleth 39	1.8E-06	--	--	--	--
Isopleth 40	6.7E-13	--	--	--	--
Isopleth 41	6.7E-09	--	--	--	--
Isopleth 42	1.7E-09	--	--	--	--
Isopleth 43	7.4E-09	--	--	--	--
Isopleth 44	5.1E-10	--	--	--	--
Isopleth 45	5.9E-09	--	--	--	--

Table 3-3. (Continued)

Isopleth or Project ^a	Isotope Emissions (Ci/yr) ^b				
	Pu-239/240	Am-241	U-233/234	U-235	U-238
Solar Ponds Plume Treatment System ^{c,d}	4.7E-06	1.9E-05	3.1E-06	1.9E-07	2.3E-06
East Trenches Plume Treatment System ^{c,d}	4.7E-07	4.8E-09	4.7E-07	7.6E-09	1.2E-07
Installation of Roof Hatch and Tank Removal, B886 ^d	--	--	--	1.9E-11	--
B788 Cluster Decommissioning, Installation of Sidewalk at B561, and Well Abandonment and Replacement ^{d,e}	8.2E-06	1.2E-05	9.4E-06	7.3E-07	3.2E-06
Drum Crushing ^d	4.6E-08	--	--	--	--

^a Isopleths are specific to each isotope and indicate zones of equal radionuclide emission potential for contaminated surface soils.

^b Emissions of all isotopes that could contribute greater than 10% of the potential EDE for a release point were estimated. Isotopes for which emissions were not estimated are shown as "--". The locations of the nonpoint release emission sources are shown in Figures 4-3 through 4-8 of this report.

^c Water spray/dust suppression used with a control efficiency of 50 percent.

^d Assumed to be uncontrolled in estimating emissions.

^e Sources combined and modeled from a central point.

Notes:

Am = Americium
 B886 = Building 886
 B788 = Building 788
 Ci/yr = Curies per year, 1 Ci = 3.7×10^{10} Becquerel (Bq)
 E# = $\times 10^{\#}$
 EDE = Effective dose equivalent
 Pu = Plutonium
 U = Uranium
 -- = Not estimated

3.3.1 Nonpoint Source Descriptions

Resuspension of Contaminated Soils by Wind Erosion: As described in Section 3.1, an ongoing source of radionuclide emissions from the Site is the resuspension of contaminated soil. Calendar year 1999 emissions from wind erosion of contaminated soil are summarized in Table 3-3 and are labeled as isopleths. Each isopleth encompasses an area of equal soil resuspension emission potential for a given isotope.

Installation of a Sidewalk Between Buildings 561 and 564: In 1999, a sidewalk was installed between Building 561 and Building 564 that resulted in soil disturbance. Radiological engineering concluded that americium levels in the soil were likely to be above the RFCA Tier II action level. Emission estimates were based on the volume of soil excavated and on estimated conservative isotopic contamination levels in the soil (Tier I action level for Am-241, and Tier II action levels for plutonium and uranium isotopes). No emission controls were used during this project.

Fiscal Year 1999 Well Abandonment and Replacement Program:

Approximately 40 monitoring wells were installed at the Site in calendar year 1999. The wells were installed to support the following five projects: actinide migration evaluation; 903 Pad/Ryan's Pit plume characterization; industrial area plume characterization; Solar Ponds Plume Treatment System; and decommissioning and demolition of Buildings 444, 771, and 886. The wells were installed using hollow stem auger and Geoprobe® technologies. Emission estimates were based on the volume of soil excavated and on conservative isotopic contamination levels in the soil. No emission controls were used during this project.

Solar Ponds Plume Treatment System: A downgradient capture and treatment system consisting of a collection trench with a treatment section in the middle was installed in 1999 to collect and treat contaminated groundwater from the SPP. The trench was filled with sand and backfilled with clean excavated soil. The treatment section was half filled with iron filings and then backfilled with uncontaminated excavated soil. Excavation of the trench was performed with a backhoe, and backfilling was performed with a front-end loader.

Emission estimates from excavation and backfilling activities were based on maximum concentrations of radionuclides in the soils, as determined from concentration maps in the SPP Interim Measures/Interim Remedial Action Environmental Assessment decision document and the volume of soil excavated and backfilled. While water spray was used to control dust, this control factor was not included in the emission calculations.

East Trenches Plume Treatment System: In 1999, a second downgradient capture and treatment system was installed near Walnut Creek, to capture contaminated

groundwater from the East Trenches area. The system consisted of a collection trench, treatment tanks containing iron filings, and a connecting corridor between the trench and tanks. The trench was filled with sand and backfilled with uncontaminated excavated soil.

Emissions estimates from excavation and backfilling activities were based on maximum concentrations of radionuclides measured from soil samples and the volume of soil excavated and backfilled. While water spray was used to control dust, this control factor was not included in the emission calculations.

Building 779 Cluster Decontamination and Demolition: Building 779 Cluster demolition was initiated in 1999. Plenum Building 729 was demolished and the remaining buildings in the cluster were not calculated but were considered decontaminated and readied for demolition. Radionuclide emissions were negligible because decontamination was performed within intact building shells and air emissions were exhausted through multiple banks of HEPA filters. Buildings were decontaminated to unrestricted release criteria levels prior to demolition. Controlled water spray was used to minimize emissions during the demolition of Building 729.

Building 788 Cluster and Clarifier Tank Demolition: The Building 788 Cluster and associated clarifier tank were demolished in 1999. The interior surfaces of Building 788 and the clarifier tank were decontaminated before demolition. The clarifier tank was dismantled using shears, nibblers, and saws. Emissions from this activity were calculated based on the maximum contamination levels found in each building or tank during characterization surveys prior to decontamination and demolition. Total areas of structures to be demolished were assumed to be contaminated with the maximum levels found in the characterization surveys. Controlled water spray was used to minimize emissions during the demolition of Building 788.

Building 886 Tank Removal: In 1999, pipes, pumps, and tanks were removed from Building 886 in preparation for closure. The project included cutting a hole in the roof of Building 886 and removing ten tanks from Room 103 using a crane. A weatherproof shoebox enclosure was constructed around the opening to allow for future use of the opening for removal of other equipment. Emissions from this activity were calculated based on conservative contamination levels from surveys performed on the ceiling surface area, and on maximum allowable air concentration levels. No emission controls were used during this project.

Drum Crushing: To reduce waste volume, a drum crushing operation was conducted in Building 984, within the Protected Area. Emission estimates assumed that this drum crushing operation would process up to 500 nonhazardous drums in 1999. The drums may have been contaminated with low levels of radionuclides. The operation did not employ emission controls.

3.3.2 Control Technology for Nonpoint Sources

Particulate emissions from significant earth-moving activities at the Site, such as those involved in the downgradient capture and treatment systems and several of the other projects listed here that required excavation, were controlled by water spray or other dust suppression measures, with an estimated control efficiency of 50 percent. Controlled water spray was also used to minimize fugitive dust emissions during demolition activities. Fugitive dust control plans that specified the control measures to be used to minimize emissions of contaminated dust were developed for each project with the potential to generate significant radionuclide emissions from soil or debris handling, or from demolition activities. Other nonpoint sources discussed above did not employ radionuclide controls.

4.0 COMPLIANCE ASSESSMENT

This section describes the compliance assessment performed for the Site for the 1999 calendar year. Because the Site has recently transitioned from the historical compliance demonstration method based on emission measurement/calculation, coupled with dispersion modeling, to an alternative sampling-based method, two separate compliance assessments are presented. In future years, only the demonstration based on environmental measurements will be presented.

4.1 Compliance Demonstration Based on Environmental Measurements

Historically, the Site has demonstrated compliance with the annual 10 mrem public dose standard in 40 CFR 61, Subpart H, through measurement and dispersion modeling of the effluent (measured point) source emissions and emission estimation and dispersion modeling of the nonpoint and calculated point source emissions, to determine the dose to the most impacted off-Site resident. Beginning with calendar year 1998, the Site transitioned to an alternative compliance demonstration method based on environmental measurements, as described below.

As the Site continues to work toward closure, buildings that contain significant quantities of radionuclide materials are being deactivated. Equipment removal and structural demolition are being carried out, with the existing ventilation systems disrupted or dismantled at some point in the process. Deactivated buildings may contain enough potentially dispersible contamination to exceed the annual monitoring threshold of 0.1 mrem (0.001 mSv) based on potential uncontrolled emissions. However, without functioning ventilation systems, normal effluent emission collection and measurement cannot be performed.

Environmental remediation projects present a similar dilemma. Radionuclide emissions occur from disturbance of contaminated soils and debris, as well as from waste treatment, handling, and packaging activities. As with building deactivation and decommissioning, normal effluent emission collection and measurement are not possible for most such activities.

As buildings are closed, and as the number of environmental remediation projects increases, the number of effluent source locations where emissions are directly collected and measured has decreased and the number of sources at the Site where emissions must be estimated has increased. Where nonpoint sources are primary contributors to dose, as has been the case at the Site since before 1995, an alternative environmental measurement approach is recommended for demonstrating compliance with the public dose standard of 40 CFR 61, Subpart H (EPA, 1991).

In recognition of this fact, DOE submitted a proposal to EPA and CDPHE in July 1997 describing an alternative compliance demonstration approach, as allowed by 40 CFR 61.93(b)(5), based on the existing perimeter RAAMP sampler network (DOE, 1997a). In December 1998, DOE submitted an addendum to the original July 1997 proposal, responding to EPA comments on the original proposed compliance sampling network (DOE, 1998). Both CDPHE and EPA have approved the final configuration of the compliance sampling network (discussed below) and the network became fully operational in 1999.

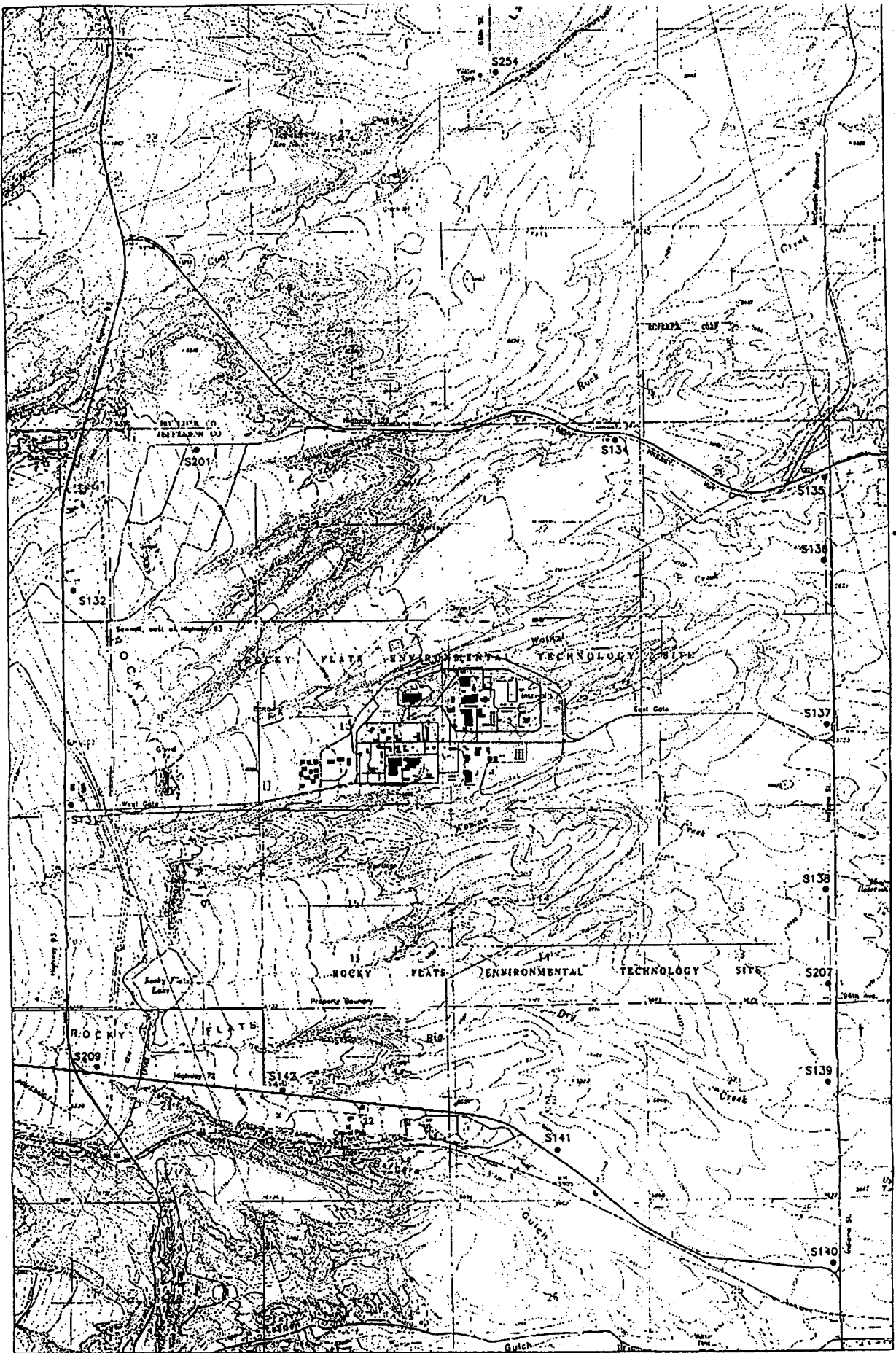
4.1.1 Description of Compliance Sampling Network

The Site operates an existing network of environmental samplers (the RAAMP network) that consists of 37 high-volume, size-fractionating ambient air samplers located on and around the Site, and in nearby communities. The compliance sampling network consists of 14 of these samplers located along the Site perimeter. Eleven of these samplers have operated for several years in their current locations. A 12th sampler located at the intersection of Highway 72 and Indiana Street ceased operation and a new sampler began operation to the north along Indiana Street during 1999. In addition, two new samplers were installed during 1999 to complete the compliance sampling network, one at the northeast corner of the Site fenceline near the intersection of Highway 128 and Indiana Street and the other due north of the center of the Site, on South 66th Street. The compliance samplers that operated in 1999 are shown in Figure 4-1.

The ambient samplers continuously collect both fine and coarse particulate fractions on filters and removable impactor surfaces that are exchanged and analyzed on a monthly schedule. The samples are analyzed for the plutonium, americium, and uranium isotopes that represent most of the radioactive materials handled at or residing on the Site. These isotopes account for all materials that have the potential to contribute 10% or more of the dose to the public.

DOE reviews residential and commercial development on or around the Site on a quarterly basis. If new development or privatization projects warrant additional or revised sampler locations, EPA and CDPHE will be notified. Sampler installation will be scheduled so that samplers will be operational when the new residence or business is occupied.

Following the transition to the alternative compliance demonstration method in 1999, effluent collection and measurement were discontinued for most insignificant release points on Site and the ambient network is now used to verify low emissions from these locations, as required by Section 61.93(b)(4). Emissions from significant release points will continue to be measured with the existing effluent sampling systems. The samplers will remain operational until the buildings are actively being decommissioned or until the operations that exceeded the 0.1 mrem trigger have ceased.



LEGEND

- SAMPLING LOCATIONS



Figure 4-1. COMPLIANCE SAMPLING NETWORK IN CALENDAR YEAR 1999

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

PROJECT NUMBER	DATE
804007.070100	05/05/00

r100063.dwg

4.1.2 Compliance Sampling Network Measurements for 1999

Filters from the compliance sampling network were exchanged monthly during 1999, then analyzed for Pu-239/240, Am-241, U-233/234, U-235, and U-238. These isotopes accounted for all materials that had the potential to contribute 10% or more of the dose to the public. Annual average isotopic concentrations were calculated at each sampler from the monthly concentration and air volume data. The annual average isotopic concentrations for each of the compliance demonstration samplers that operated in 1999 are shown in Table 4-1.

Sampler S-140, located at the corner of Highway 72 and Indiana Street, ceased operation in September 1999 and a new sampler, S-139, began operation to the north along Indiana Street. Samplers S-135 and S-254 are new samplers that also began operation during September 1999. The concentration values shown in Table 4-1 for these four samplers are therefore based on a partial year of sampling data.

Table 4-1. Annual Isotopic Concentrations at Compliance Sampling Network Locations for Calendar Year 1999

Sampler	Pu-239/240 (Ci/m ³)	Am-241 (Ci/m ³)	U-233/234 (Ci/m ³)	U-235 (Ci/m ³)	U-238 (Ci/m ³)	Fractional Sum
S-131	1.10 E-18	1.46E-18	3.16 E-17	2.02E-18	2.90E-17	0.0096
S-132	4.40E-18	1.23E-18	4.33 E-17	2.14 E-18	4.38 E-17	0.0145
S-134	5.81E-19	2.60E-19	1.95E-17	1.31 E-18	1.75 E-17	0.0055
S-135	9.03E-19	7.64E-19	3.60E-17	2.31E-18	3.59E-17	0.0106
S-136	1.72E-18	4.21E-19	2.13E-17	1.18E-18	1.90E-17	0.0065
S-137	2.26 E-18	4.56E-19	2.36 E-17	1.15 E-18	2.45 E-17	0.0078
S-138	1.38 E-18	3.19E-19	2.19 E-17	1.79E-18	2.00 E-17	0.0066
S-139	8.88E-19	5.73E-19	2.87E-17	1.31E-18	2.74E-17	0.0083
S-140	4.65E-19	4.82E-19	5.19E-17	2.74E-18	5.25E-17	0.0145
S-141	1.59E-18	2.58E-19	2.31E-17	1.52E-18	2.46E-17	0.0074
S-142	4.58E-19	4.68E-19	2.36E-17	1.66E-18	2.45E-17	0.0070
S-201	1.24E-18	5.81E-19	2.96E-17	1.59E-18	2.76E-17	0.0086
S-207	1.09E-18	2.77E-19	3.06E-17	1.67E-18	2.77E-17	0.0086
S-209	5.62E-19	4.15E-20	2.90E-17	1.64E-18	3.14E-17	0.0084
S-254	4.35E-19	4.39E-19	2.32E-17	1.65E-18	2.90E-17	0.0074
Compliance Level (Ci/m ³) ^a	2.0 E-15	1.9 E-15	7.1/7.7 E-15	7.1 E-15	8.3 E-15	1

^a Compliance levels are listed for each isotope in Table 2 of Appendix E to 40 CFR 61.

Notes:

Am = Americium
 Ci/m³ = Curies per cubic meter; 1 Ci = 3.7 x 10¹⁰ Becquerel (Bq)
 E# = x 10[#]
 Pu = Plutonium
 U = Uranium

The fractional sum was calculated for each sampler location by dividing each annual isotopic concentration by that isotope's corresponding compliance level in Table 2 of Appendix E to 40 CFR 61, then summing the fractions. The fractional sums are also shown in Table 4-1.

4.2 Compliance Demonstration Based on Modeling

The Site has agreed to provide a modeling-based compliance assessment during the transition period for comparison with the sampling-based assessment described above. This section discusses the modeling-based dose assessment for calendar year 1999.

4.2.1 Description of Dose Model

The Site used the dose model CAP88-PC (Version 1.0) for calculating EDE to the public. CAP88 is specified in 40 CFR 61, Subpart H, for modeling air pathway dose from DOE facilities such as Rocky Flats. The model simulates the dispersion of airborne radionuclide emissions from point and nonpoint (termed "area") sources to user-specified receptor locations, then calculates an annual, multipathway EDE for a person living or working at each specified receptor location.

The model accounts for dose received from Site emissions through inhalation and ingestion of radionuclides, as well as through irradiation from radionuclides in air and deposited on the ground surface. To simulate pollutant dispersion and calculate dose, the model requires the following types of input data:

- Distance and direction from emission sources to receptor locations.
- Source release characteristics including stack locations, stack heights, exhaust gas velocities and temperatures, the size of each stack or vent opening for point sources, and the size and location of each area source.
- The amount of each radioactive isotope released from each source.
- Meteorological data including the annual distribution of wind speed, wind direction, and atmospheric stability at the Site, and annual precipitation and temperature information. The model also requires information about the average height of regional temperature inversions (mixing height).
- Agricultural data used in calculating radionuclide ingestion rates including the location, distribution, and utilization of local sources of meat, milk, and vegetables.
- Miscellaneous data regarding the size and solubility of particles emitted.

The input data used in calculating the calendar year 1999 Site dose to the public are discussed in Section 4.2.2.

4.2.2 Summary of Model Input Data

This section describes the dose model input data used to calculate EDE to the public for calendar year 1999.

Receptors

Compliance with the 10 mrem (0.1 mSv) public dose standard of 40 CFR 61.92 was determined by calculating the highest EDE to any member of the public at any off-Site point where there is a residence, school, business, or office. Modeling was performed for eight receptor locations, shown on Figure 4-2. These locations represent the residences, businesses, schools, and office buildings nearest the Site. Modeling determined that the maximally exposed individual (MEI) for 1999 was located at a distance of 4,247 m to the east-southeast of the central, industrial portion of the Site. The model input data described in the rest of Section 4.2.2 are those values used to calculate the MEI dose for 1999.

Point Source Input Data

For calendar year 1999, emissions from point sources included measured emissions from building stacks and vents, which were modeled from a single location within the central area of the Site, and calculated point source emissions, including emissions from glovebox removal operations in Building 779, Building 776 process waste tanks, 904 Pad repackaging operations, 750 Pad sampling and repackaging, and tritium emissions from Building 790 and the Thermo NUtech laboratory.

Combined point source emissions were modeled at the shortest actual point source release height using a conservative stack diameter (based on actual stack data) and an exit velocity characteristic of obstructed flow (such as would occur at a release point with a nonvertical stack or rain cap). Several sets of stack parameters were screened and the set that would result in the highest point source EDE to the public was used in the modeling analysis.

Figure 4-3 shows the location of individual emission sources, including those that were combined for modeling purposes, and the location from which the combined emissions were modeled. Figure 4-3 also shows the building locations from which calculated tritium emissions occurred: Building 790 and the Thermo NUtech laboratory. Table 4-2 shows the release characteristics for all the point sources listed above.

Detailed information regarding individual release points is given in Appendix D.

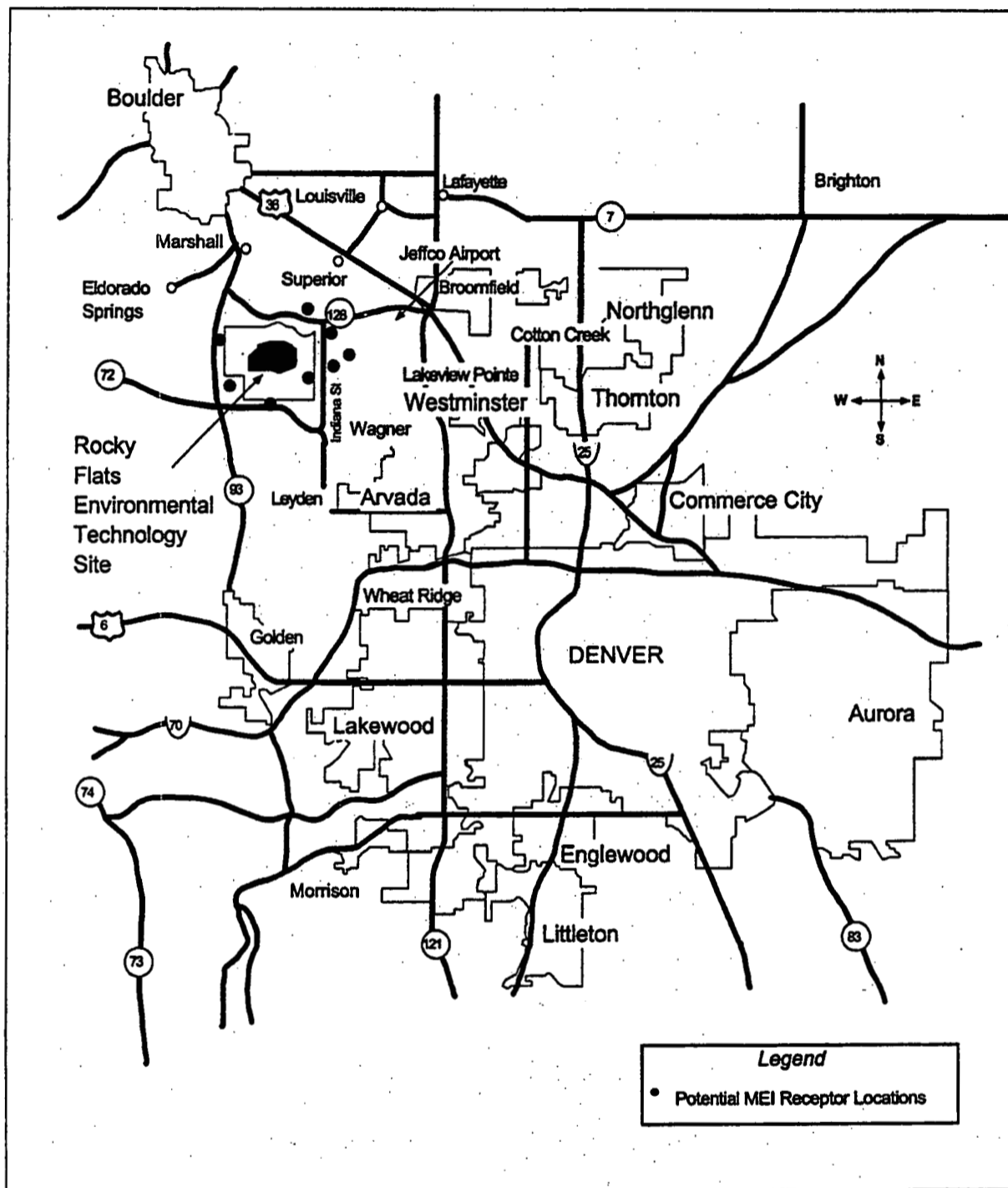


Figure 4-2. Receptor Locations for 1999 Dose Analysis

Figure 4-3. Industrial Area Source Locations

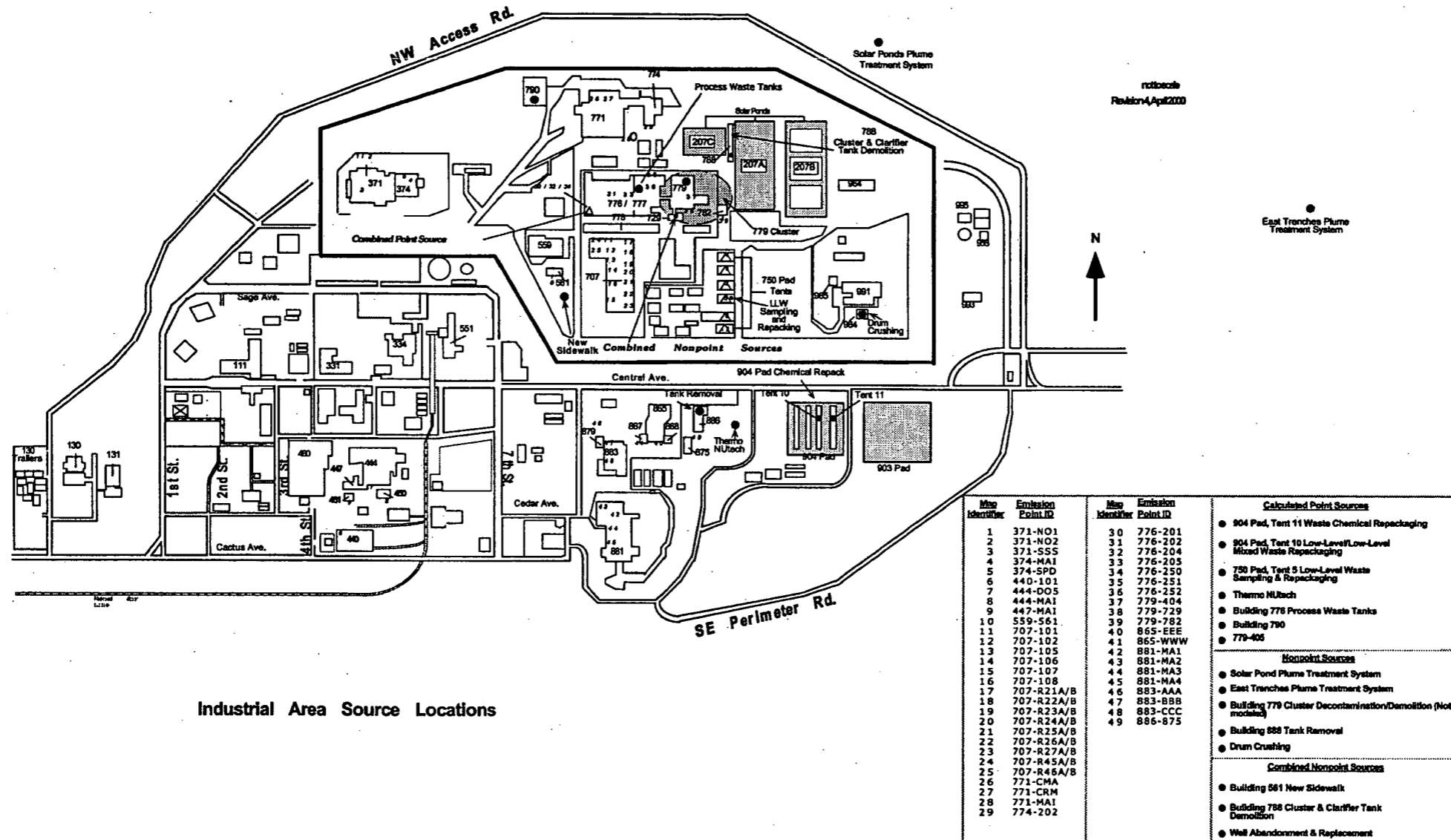


Table 4-2. Source Data for Model Input—Point Sources

Source	Height (m)	Diameter (m)	Exit Velocity (m/s)	Distance to MEI (m)	Direction to MEI
Combined Sources	4.0	0.4	0.1	4,247	ESE
904 Pad Repackaging	4.6	0.6	13.2	3,934	ESE
750 Pad Sampling and Repackaging	5.0	0.2	0.5	3,886	ESE
Building 779 Glovebox Removal	4.0	0.4	0.1	4,059	ESE
Calculated Tritium from Building 790 and Thermo NUtech	10.0	1.1	8.3	4,274	ESE
Building 776 Process Waste Tanks	4.0	0.4	0.1	4,247	ESE

Notes:

ESE = East-southeast
m = Meters
m/s = Meters per second
MEI = Maximally exposed individual

4.2.3 Nonpoint Source Input Data

As described in Section 3.1, emissions from wind resuspension of contaminated soil were estimated based on surface soil radionuclide concentration isopleths for the Site that have been developed based on a Site-specific soil sampling database, combined with geographic information system (GIS) software. The GIS was used to compute the area of each isopleth, the centroid of each isopleth (representing the center of mass of the radionuclide contamination), and the distances from each centroid to each receptor. The area of each isopleth and the distance and direction to the MEI receptor are shown in Tables 4-3 through 4-7 for each of the isotopes modeled.

CAP88-PC simulates each nonpoint source as a point source at the centroid of the source area. The location of the individual nonpoint (area) sources that were modeled representing the Solar Ponds Plume Treatment System, the East Trenches Plume Treatment System, the installation of a roof hatch and tank removal from Building 886, and drum crushing at Building 984, are shown in Figure 4-3. Figure 4-3 also shows the location of the following three sources that were combined as one nonpoint source: the Building 788 Cluster and clarifier tank demolition, the installation of a sidewalk at Building 561, and the well abandonment and replacement project. (Note: Although the location of the Building 779 cluster decontamination and demolition project is also shown in Figure 4-3, emissions from this activity were not modeled, because they were clearly negligible compared with other calendar year 1999 sources.) Source input data for these sources are listed in Table 4-8. The soil resuspension isopleth centroid locations are shown in Figures 4-4 through 4-8.

Table 4-3. Plutonium-239/240 Nonpoint Source Model Input Data^a

Isopleth No.	Area (m²)	Distance to MEI (m)^b	Direction to MEI^b
Isopleth 1	31,621	3,489	ESE
Isopleth 2	109,827	3,385	ESE
Isopleth 3	1,406,130	2,693	SE
Isopleth 4	14,649	4,055	ESE
Isopleth 5	246	4,306	ESE
Isopleth 6	6,151,373	2,272	ESE
Isopleth 7	1,744	4,218	ESE
Isopleth 8	5,365	4,363	ESE
Isopleth 9	53,466	4,235	ESE
Isopleth 10	4,100	4,066	ESE
Isopleth 11	3,812	861	E
Isopleth 12	59,112	3,484	ESE
Isopleth 13	2,861	4,068	ESE
Isopleth 14	1	2,274	SE
Isopleth 15	310,084	3,304	ESE
Isopleth 16	45,243	3,486	ESE
Isopleth 17	178,780	3,319	ESE
Isopleth 18	4,197	6,290	SE
Isopleth 19	35,290	4,797	SE
Isopleth 20	9,829	5,073	SE
Isopleth 21	6,995	4,910	SE
Isopleth 22	1,998,185	6,402	ESE
Isopleth 23	12,931,100	2,533	ESE
Isopleth 24	3,729	4,133	SE
Isopleth 25	76,129	4,574	SE
Isopleth 26	9,136	5,721	ESE
Isopleth 27	298	4,783	SE
Isopleth 28	43,971	5,411	ESE
Isopleth 29	509	4,779	ESE
Isopleth 30	39,455	4,025	SE
Isopleth 31	19,397	3,561	ESE
Isopleth 32	4,033	4,344	ESE
Isopleth 33	78,358	4,803	ESE
Isopleth 34	51,843	4,004	ESE
Isopleth 35	1,754	5,785	ESE
Isopleth 36	2,146	4,912	ESE
Isopleth 37	19,198	4,497	E
Isopleth 38	79	4,583	SE
Isopleth 39	8,141,819	2,312	ESE

Table 4-3. (Continued)

Isopleth No.	Area (m ²)	Distance to MEI (m) ^b	Direction to MEI ^b
Isopleth 40	3	2,448	SSE
Isopleth 41	30,895	4,365	ESE
Isopleth 42	7,939	4,055	SE
Isopleth 43	33,929	2,980	E
Isopleth 44	2,364	3,421	E
Isopleth 45	27,166	3,594	E

^a All isopleths were modeled with heights of 0.0 m and no momentum plume rise (0.0 m/s exit velocity). Emissions are shown in Table 3-3.

^b From isopleth centroids.

Notes:

E = East
 ESE = East-southeast
 m = Meters
 m² = Square meters
 m/s = Meters per second
 MEI = Maximally exposed individual
 SE = Southeast
 SSE = South-southeast
 -- = Not applicable

Table 4-4. Americium-241 Nonpoint Source Model Input Data^a

Isopleth No.	Area (m ²)	Distance to MEI (m) ^b	Direction to MEI ^b
Isopleth 1	6,759	3,545	ESE
Isopleth 2	36,197	3,486	ESE
Isopleth 3	30,550	3,982	ESE
Isopleth 4	129,755	3,358	ESE
Isopleth 5	1,966,672	2,680	SE
Isopleth 6	15,770	3,539	ESE
Isopleth 7	6,408	3,414	ESE
Isopleth 8	12,747	3,972	ESE
Isopleth 9	69,041	3,438	ESE
Isopleth 10	1,817	3,413	ESE
Isopleth 11	9,837	3,543	ESE
Isopleth 12	48,366	3,480	ESE
Isopleth 13	49,267	3,960	ESE
Isopleth 14	4,094	4,185	ESE
Isopleth 15	4,995	3,019	ESE
Isopleth 16	38	3,342	ESE
Isopleth 17	206,852	3,294	ESE
Isopleth 18	36,199	4,564	ESE
Isopleth 19	6,497,859	2,514	ESE
Isopleth 20	1,212	4,439	ESE
Isopleth 21	350	3,709	SE
Isopleth 22	11,803	4,736	ESE
Isopleth 23	48,063	4,387	ESE
Isopleth 24	156,161	5,012	ESE
Isopleth 25	1,757	4,682	ESE
Isopleth 26	32,708	4,238	ESE
Isopleth 27	0	4,159	ESE
Isopleth 28	7,070	3,363	E
Isopleth 29	2,890	3,421	E
Isopleth 30	443,953	3,610	E
Isopleth 31	22	3,015	E
Isopleth 32	899	3,880	E
Isopleth 33	3,115,832	2,491	SE

^a All isopleths were modeled with heights of 0.0 m and no momentum plume rise (0.0 m/s exit velocity). Emissions are shown in Table 3-3.

^b From isopleth centroids.

Notes:

E = East
 ESE = East-southeast
 m² = Square meters
 m/s = Meters per second
 m = Meters

MEI = Maximally exposed individual
 SE = Southeast

Table 4-5. Uranium-233/234 Nonpoint Source Model Input Data^a

Isopleth No.	Area (m ²)	Distance to MEI (m) ^b	Direction to MEI ^b
Isopleth 1	9,893	3,994	ESE

^a All isopleths were modeled with heights of 0.0 m and no momentum plume rise (0.0 m/s exit velocity). Emissions are shown in Table 3-3.

^b From isopleth centroids.

Notes:

ESE = East-southeast
m = Meters
m² = Square meters
m/s = Meters per second
MEI = Maximally exposed individual

Table 4-6. Uranium-235 Nonpoint Source Model Input Data^a

Isopleth No.	Area (m ²)	Distance to MEI (m) ^b	Direction to MEI ^b
Isopleth 1	61,275	4,037	ESE
Isopleth 2	908	4,188	ESE
Isopleth 3	19,734	4,545	ESE
Isopleth 4	8,105	3,669	ESE
Isopleth 5	16,683	4,564	ESE
Isopleth 6	82,668	5,115	ESE

^a All isopleths were modeled with heights of 0.0 m and no momentum plume rise (0.0 m/s exit velocity). Emissions are shown in Table 3-3.

^b From isopleth centroids.

Notes:

ESE = East-southeast
m = Meters
m² = Square meters
m/s = Meters per second
MEI = Maximally exposed individual

Table 4-7. Uranium-238 Nonpoint Source Model Input Data^a

Isopleth No.	Area (m ²)	Distance to MEI (m) ^b	Direction to MEI ^b
Isopleth 1	6,323	4,550	ESE
Isopleth 2	1,842	4,519	ESE
Isopleth 3	27,479	5,151	E
Isopleth 4	5,270	4,546	ESE

^a All isopleths were modeled with heights of 0.0 m and no momentum plume rise (0.0 m/s exit velocity). Emissions are shown in Table 3-3.

^b From isopleth centroids.

Notes:

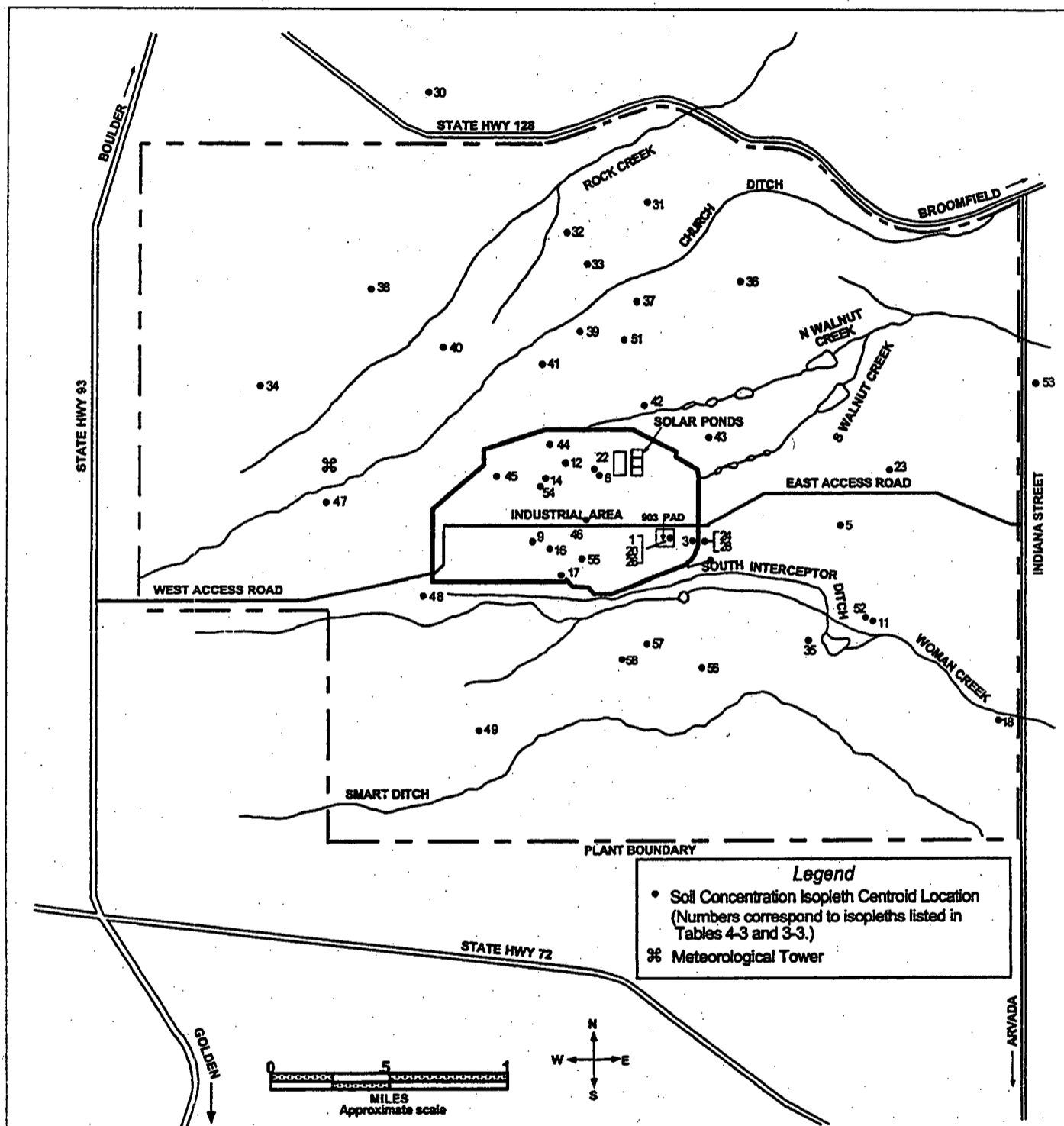
E = East
 ESE = East-southeast
 m = Meters
 m² = Square meters
 m/s = Meters per second
 MEI = Maximally exposed individual

Table 4-8. Source Data for Model Input—Nonpoint Sources and Nonmonitored Point Sources

Parameter	Solar Pond Plume Treatment System	East Trenches Plume Treatment System	Installation of Roof Hatch and Tank Removal-B886	Drum Crushing	B788 Cluster/Tank Demolition, Sidewalk at B561, Well Abandonment & Installation
Height (m)	--	--	3.7	4.0	--
Stack Diameter	--	--	1.4	0.4	--
Area (m ²)	452	2,900	--	--	0
Exit Velocity (m/s)	--	--	0.01	0.1	--
Distance to MEI (m)	3,719	3,719	3,934	3,706	4,059
Direction to MEI	ESE	ESE	ESE	ESE	ESE

Notes:

ESE = East-southeast
 B561 = Building 561
 B886 = Building 886
 B788 = Building 788
 m = Meters
 m² = Square meters
 m/s = Meters per second
 MEI = Maximally exposed individual
 -- = Not applicable



**Figure 4-4. Soil Concentration Isopleth Centroid Locations
For Plutonium-239/240**

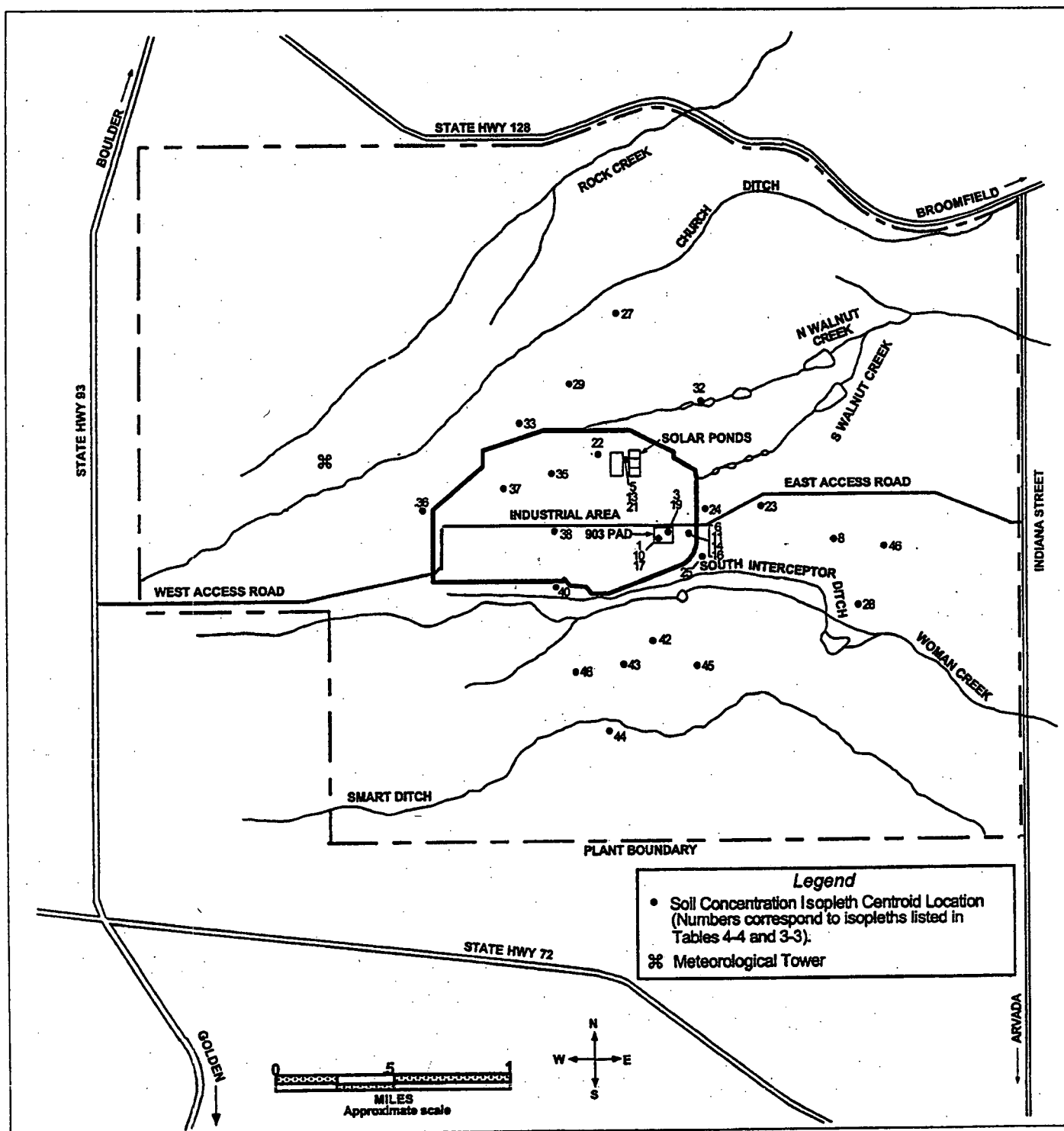


Figure 4-5. Soil Concentration Isopleth Centroid Locations for Americium-241

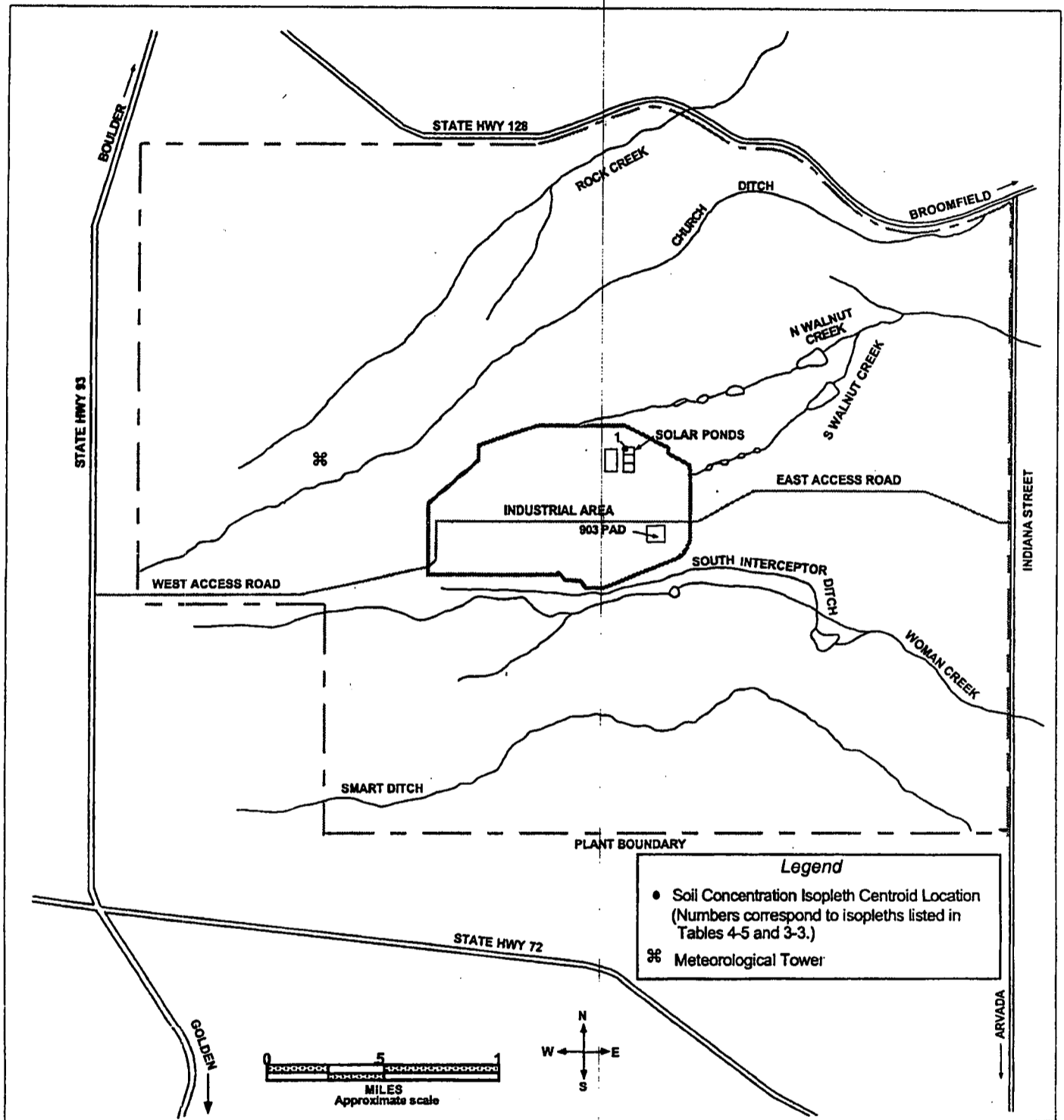


Figure 4-6. Soil Concentration Isopleth Centroid Location for Uranium-233/234

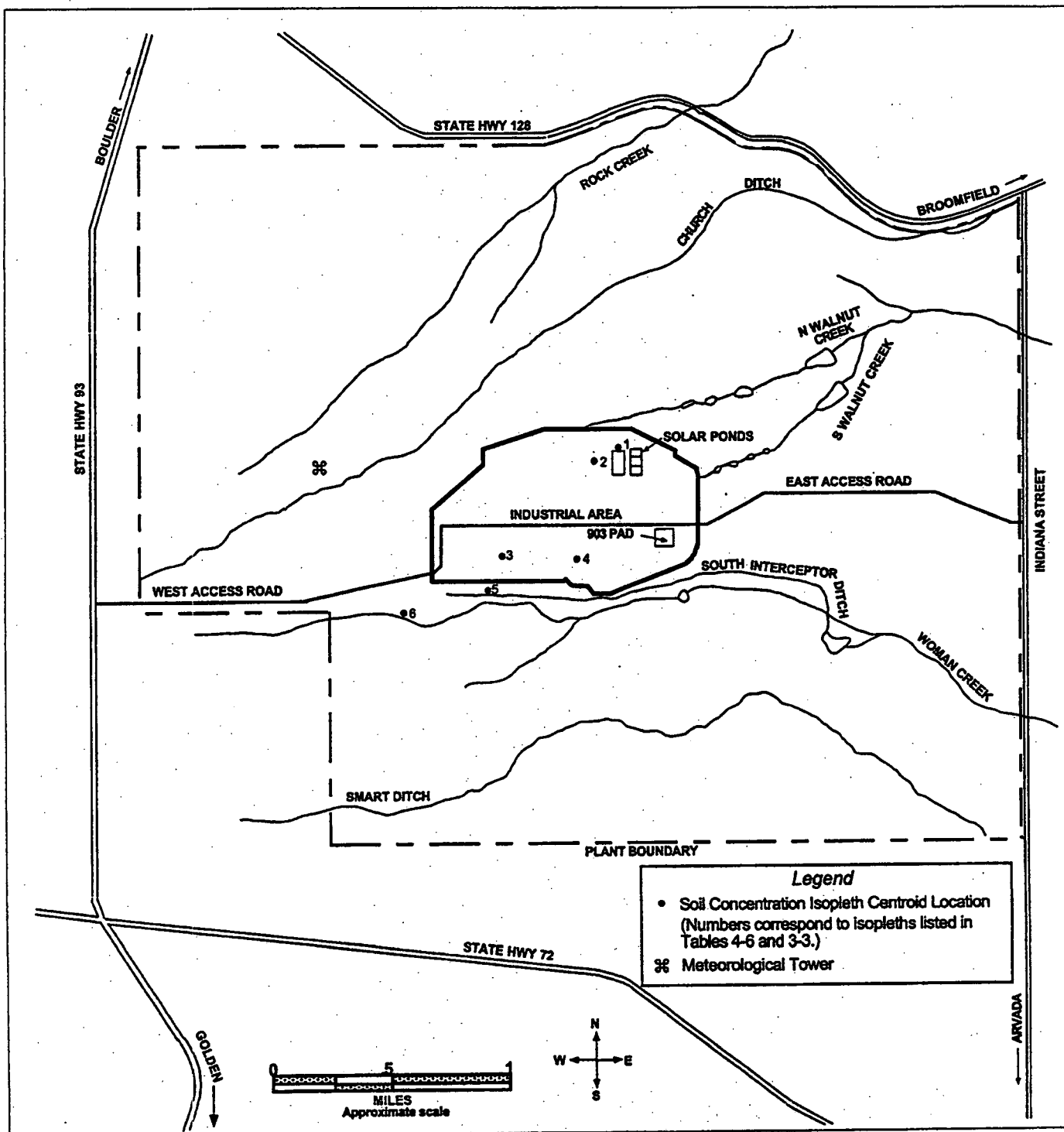


Figure 4-7. Soil Concentration Isopleth Centroid Locations for Uranium-235

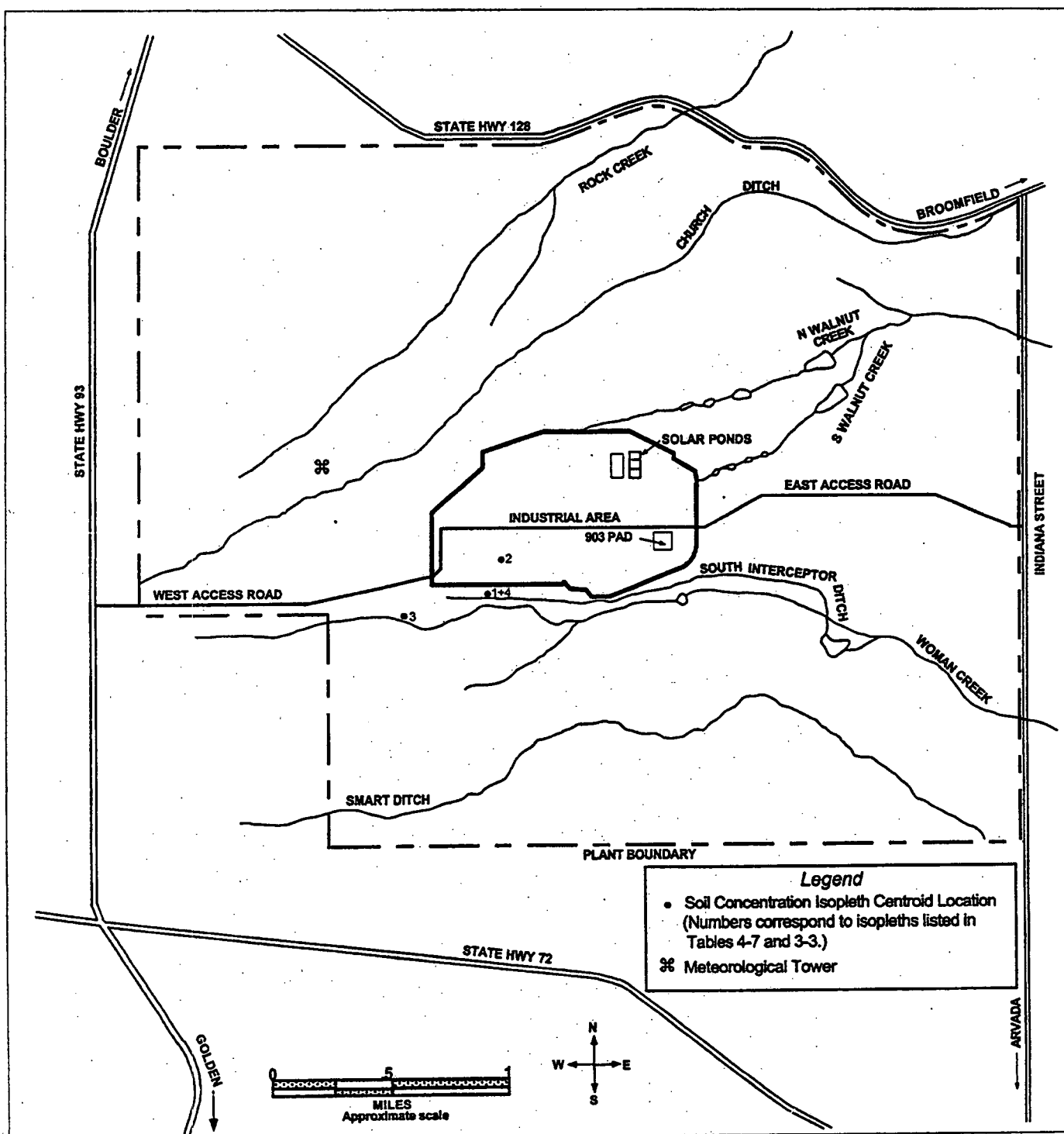


Figure 4-8. Soil Concentration Isopleth Centroid Locations for Uranium-238

4.2.4 Meteorological Data

Meteorological data for calendar year 1999 were collected from a tower located in the western portion of the Site (the tower location is shown in Figures 4-4 through 4-8). A joint frequency distribution of wind speed, wind direction, and stability was processed for input to CAP88-PC. A "wind rose" graphic representation of the meteorological data is shown in Figure 4-9. Appendix E gives a detailed list of the joint frequency meteorological data for 1999. Annual precipitation and temperature data collected on Site for 1999 are summarized in Table 4-9. An average mixing height for the Denver, Colorado, area of 1,405 m was used in the model (EPA, 1972).

4.2.5 Other Input Data

The CAP88-PC model also requires other input data. Model default values were used for the median aerodynamic diameter (1.0 micrometers [μm]) and solubility class. Urban agricultural data were used in the model and are shown in Table 4-10. Default values were also used for the origin of food products, as shown in Table 4-11.

The shortest distance between a Site radionuclide release point and farmland producing agricultural products is 720 m for beef cattle, 1,063 m for dairy cattle, and 1,063 m for cropland.

Appendix F summarizes the model input data used for this assessment.

Table 4-9. Additional Meteorological Data for Model Input

Input	Value Used
Wind Data	From on-Site tower at 10 m height
Annual Precipitation ^a	45.24 cm
Annual Average Temperature ^b	10.48°C
Mixing Height ^c	1,405 m

^a Total precipitation equivalent for 1999 (rainfall and snowfall).

^b Average of monthly average temperatures.

^c Average of annual morning and afternoon mixing heights for Denver from Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States (EPA, 1972).

Notes:

°C = Degrees Celsius

cm = Centimeter

EPA = U.S. Environmental Protection Agency

m = Meter

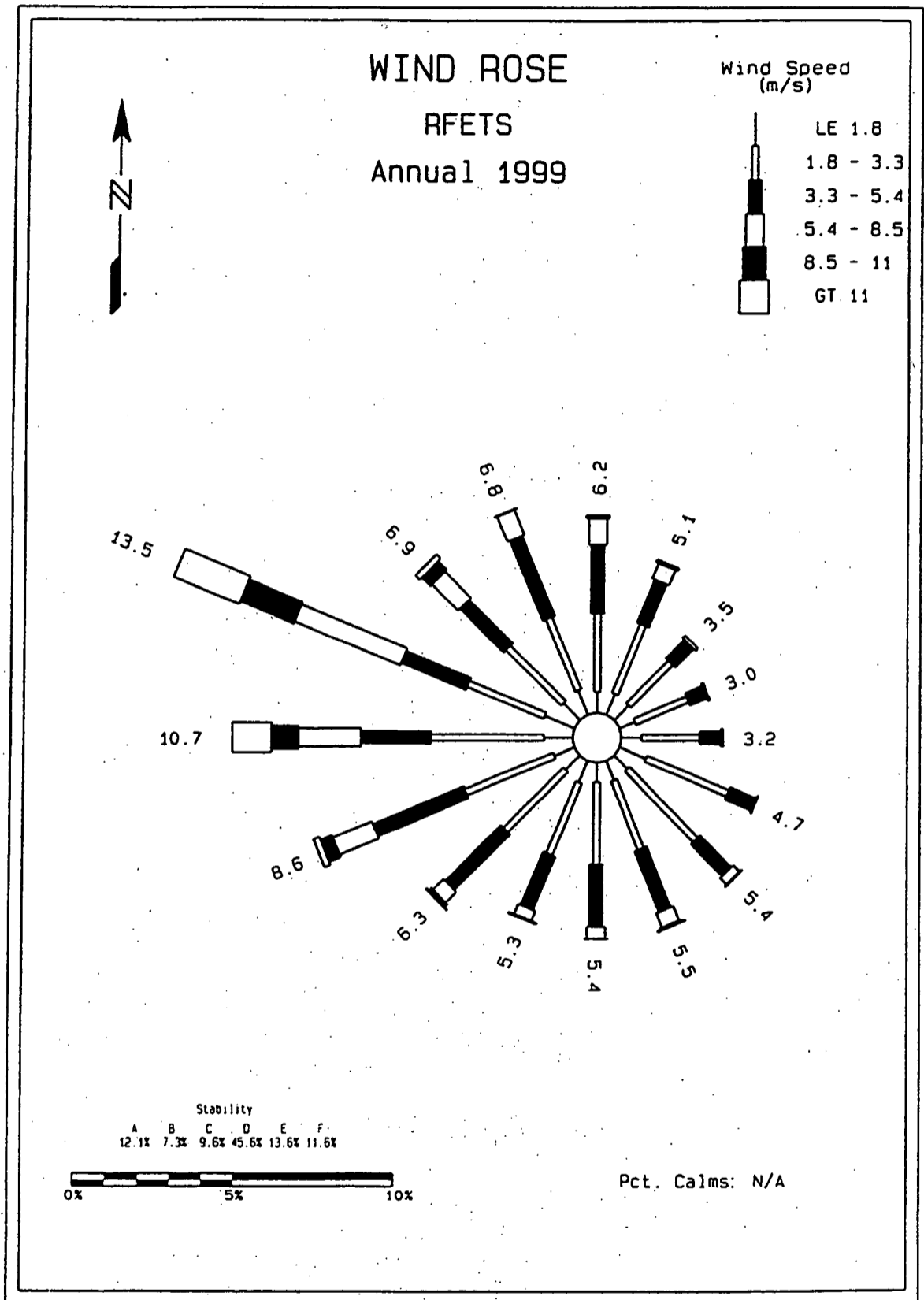


Figure 4-9. Wind Frequency Distribution for 1999

Table 4-10. Agricultural Data for Model Input

Input	Value Used
Source	Urban
Beef Cattle Density ^a	1.13 E-01 cattle/km ²
Milk Cattle Density ^a	3.50 E-03 cattle/km ²
Land Fraction Cultivated for Vegetable Crops ^a	1.39 E-02

^a Model default values.

Notes:

E# = x 10[#]
 km² = Square kilometers

Table 4-11. Origin of Food Products

Origin	Food Product		
	Vegetable	Milk	Beef
Fraction Home Produced ^a	0.076	0.0	0.008
Fraction From Assessment Area ^a	0.924	1.0	0.992
Fraction Imported ^a	0.0	0.0	0.0

^a Model default values.

4.3 Compliance Assessment Results

This section discusses the results of both the sampling-based and modeling-based compliance assessments that were performed for calendar year 1999.

4.3.1 Compliance Demonstration Based on Environmental Measurements

As reported in Section 4.1 of this report, the maximum annual concentrations of Pu-239/240, Am-241, U-233/234, U-235, and U-238 measured at the compliance sampling network were compared to the compliance levels listed in Table 2 of Appendix E to 40 CFR 61. In each case, the maximum measured concentration of each isotope, as shown in Table 4-1, was less than 1% of the corresponding compliance level. In addition, the fractional sum of all isotopes at the "critical receptor" location (the sampler showing the highest concentrations in 1999) was determined to be 0.0145. The facility is in compliance when the annual concentration of each isotope is less than its corresponding Table 2 compliance level and when the fractional sum of all isotopes is less than 1. (Note: Tritium is not measured at the compliance samplers; however, tritium dose calculated in the modeling analysis discussed in Section 4.2 would add less than 0.0000001 mrem.)

Figure 4-10 shows data from the 1999 compliance sampling network at all locations. The data are presented as percentages of the compliance level for each isotope; the total height of each bar in Figure 4-10 represents the fractional sum expressed as a percent of the allowable sum (percent of 1). Data are presented for each sampler, beginning with S-131 at the west gate of the Site, and continuing around the Site perimeter in a clockwise direction. Sampler locations are shown in Figure 4-1.

The maximum measured radionuclide levels occurred to the northwest of the Site, at sampler S-132, and to the southeast of the Site, at sampler S-140. These two locations also showed the highest radionuclide levels measured at the perimeter samplers during calendar years 1997 and 1998.

Examination of the isotopic data presented in Table 4-1 and Figure 4-10 shows that the higher overall radionuclide levels (fractional sums) at S-132 and S-140, relative to other samplers in the compliance sampling network, were primarily due to higher levels of U-233/234 and U-238. The ratio of U-233/234 to U-238 activities at S-132 and S-140 (and at other compliance samplers as well) was approximately 1:1, which is characteristic of naturally occurring uranium. (In contrast, depleted or enriched uranium that might be emitted from on-Site sources would show either lower or higher isotopic ratios.) S-132 and S-140 are both located in areas that might be expected to show elevated dust levels due to traffic or quarrying activities. The soils surrounding Rocky Flats contain naturally occurring uranium, which may explain the elevated activities at these samplers.

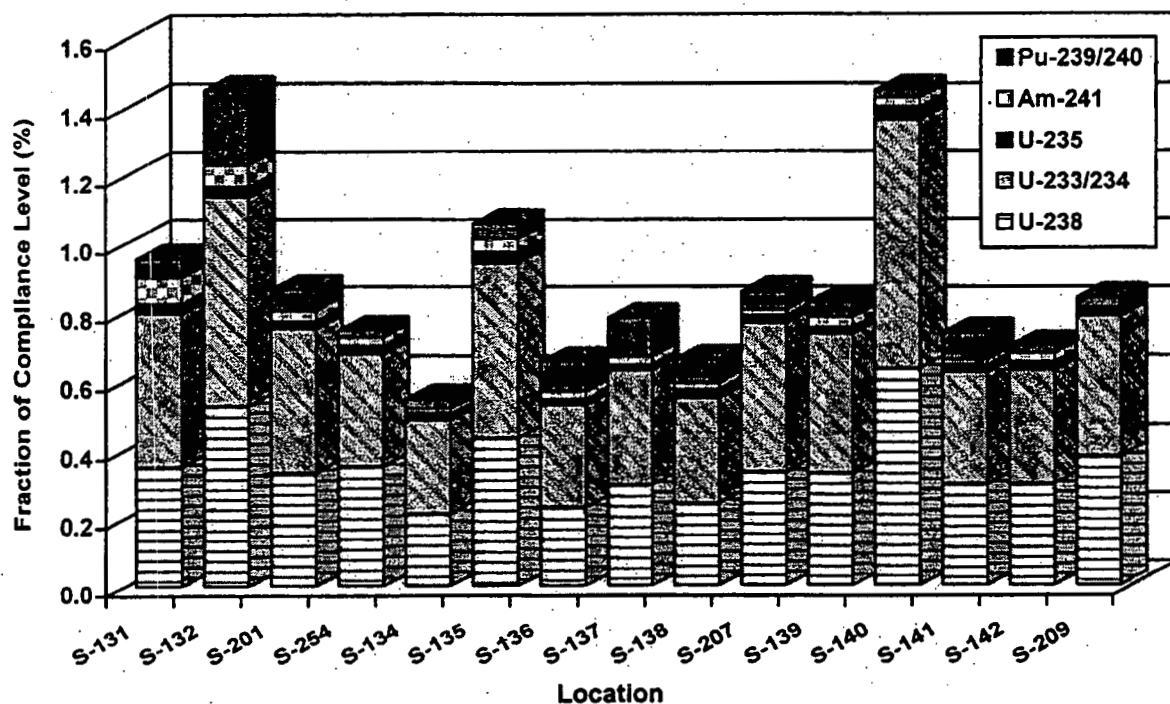


Figure 4-10. Environmental Measurements of Airborne Radionuclides in 1999

Naturally occurring uranium isotopes appear to have dominated the airborne radionuclide levels at all the compliance samplers in 1999. In fact, the fraction of the compliance levels represented by U-233/234 and U-238 was nearly an order-of-magnitude greater than that represented by the sum of the fractions of the other three radionuclides sampled (Pu-239/240, Am-241, and U-235).

Figure 4-12 shows the measured levels of Pu-239/240 and Am-241 at the compliance sampling network locations, also presented as percentages of the compliance level for each isotope. These two isotopes are characteristic of the weapons grade plutonium that was used in nuclear weapon component production operations at the Site; these radionuclides present a different pattern than U-233/234 and U-238. The pattern seen in 1999 also differs somewhat from previous years, as explained below.

In 1998, maximum plutonium levels occurred at sampler S-137, located due east of the center of the Site. Based on annual average wind patterns, sampler S-137 is generally downwind of the 903 Pad and surrounding areas, which have represented a major source of plutonium emissions from the Site in recent years due to resuspension of contaminated surface soils. In 1999, however, maximum plutonium concentrations occurred to the northwest of the Site, at sampler S-132. Maximum americium concentrations occurred to the west of the Site in 1999, at sampler S-131.

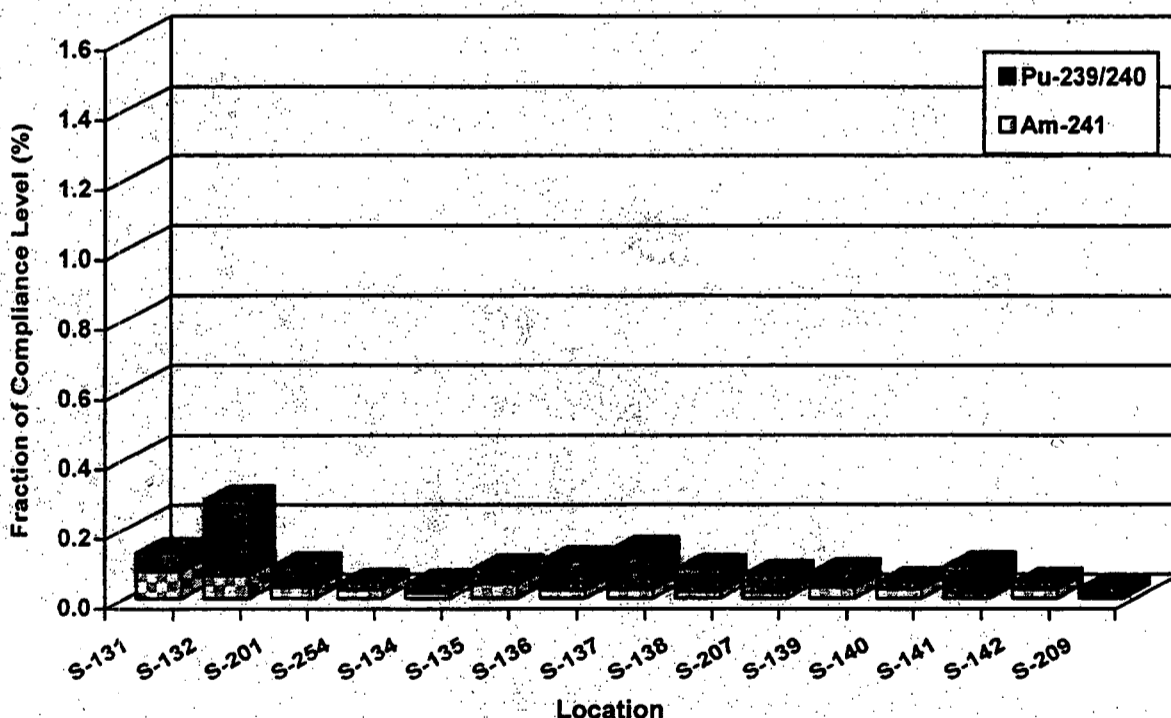


Figure 4-11. Environmental Measurements of Pu-239 and Am-241 in 1999

The higher plutonium concentration recorded at sampler S-132 is thought to be a laboratory reporting error. The results for the February 1999 fine fractions indicate a possible mixup in the fiberglass filters for two locations, S-132 and S-107. Sampler S-107, which is not part of the compliance sampling network, is located just to the east of the 903 Pad and routinely shows airborne Pu-239/240 concentrations one to two orders of magnitude higher than at the perimeter samplers. During February, the Pu-239/240 concentration reported for S-132 was of the magnitude normally observed at S-107, while the reported S-107 concentration was considerably lower than historical values. These concentrations are uncharacteristic for these locations.

The coarse fraction, which is collected on a separate filter pad, did not show the same pattern as the fine fraction data in February; instead, coarse fraction concentrations appeared similar to historical values for these two locations. In addition, there was no known release on Site during February that would have led to the Pu-239/240 concentration as reported for S-132. However, because the probable error could not be confirmed, Pu-239/240 (and other radionuclide) data have been reported here as received from the laboratory.

Sampler S-131 recorded somewhat elevated americium concentrations, relative to the other compliance sampling network locations, for unknown reasons. No laboratory errors were apparent from the data, nor were there any known project emission events that would have produced the elevated Am-241 that was recorded at this location. Monthly concentration data from S-131 showed higher than average concentrations several times during the year, not just in a single period where a specific project could be the cause. Although the resulting Am-241 concentrations at the fenceline were very low, they represent a departure from the usual pattern seen for this airborne radionuclide.

4.3.2 Compliance Demonstration Based on Modeling

The EDEs calculated for each modeled emission source were summed for each receptor and the MEI determined. The maximum off-Site calendar year 1999 EDE from all Site emissions was 0.004 mrem (0.00004 mSv), less than 0.05% of the 10 mrem (0.1 mSv) standard. The MEI was a residence located approximately 4,247 m to the east-southeast of the center of the Site's industrial area (the closest sampler was S-138). The modeling-based dose calculated for 1999 and the direction of the MEI from the center of the industrial area can be compared to the maximum off-Site EDEs calculated in recent years as follows:

- 1999: 0.004 mrem (east-southeast)
- 1998: 0.041 mrem (east-northeast)
- 1997: 0.004 mrem (east-southeast)
- 1996: 0.3 mrem (northeast)
- 1995: 0.008 mrem (southeast)

In 1996, the maximum modeled off-Site EDE reflected the contributions of two projects that resulted in short-term, elevated radionuclide emissions. Calendar years 1995 and 1997, in contrast, had routine emissions without significant project contributions, while modeling analyses for 1998 and 1999 reflected a mix of emissions from natural resuspension of contaminated soils and emissions from a variety of projects and activities. Approximately half the 1999 maximum modeled off-Site EDE was contributed by wind-blown contaminated soils, while the rest was due to project activities. Stack (effluent) emissions and tritium emissions contributed less than 1% of the modeled dose.

One of the limitations of the modeling method is that Site emissions from nonpoint sources must be estimated, rather than directly collected and quantified. In 1999, as in previous years, emissions were calculated in pre-project evaluations, using expected "worst case" project assumptions, combined with emission factors mandated by EPA for decision making regarding whether construction approval is needed for a given project. Those emission factors, along with the CAP88-PC model, are designed to be conservative; that is, to ensure that emissions and dose are not underestimated. As a result, for most projects, the project contributions to the modeling-based EDE will be overestimated. However, if contaminant levels or distributions do not match pre-project sampling data, project contributions may be underestimated. In this respect, the measurement-based compliance data present a more realistic estimate of actual public exposure.

The location of maximum impact predicted by the modeling analysis reflects the prevailing west-northwesterly wind flow at the Site (see Figure 4-9), coupled with emissions from the 903 Pad area and from projects that took place in and near the northern portion of the industrial area. In general, there has been a shift in the MEI as new residences or businesses have moved closer to the Site. The MEI locations in 1999, 1998, and 1997 represent recently constructed residences that were not included in previous years' modeling analyses.

4.3.3 Comparison of Compliance Demonstrations

The two compliance demonstrations performed for this report showed somewhat different information about public dose for calendar year 1999. While both methods demonstrated that the potential off-Site dose due to Site activities was well below the 10-mrem standard, the results differed in terms of the magnitude and location of the maximum potential dose, as well as the isotopic breakdown.

The measurement-based demonstration suggested a higher overall potential dose than the modeling demonstration (equivalent to approximately 0.145 mrem, compared to 0.004 mrem from modeling). As noted earlier, however, the measured concentrations

have large contributions from naturally occurring uranium isotopes that are excluded from the model estimates. As a result, the locations of maximum potential dose also differed between the two demonstrations. The maximum measured concentrations occurred to the southeast and northwest of the Site, in locations where local dust sources would affect measured concentrations. The MEI location, as determined by modeling, occurred at the closest receptor that was "downwind" from contaminated soil areas and from projects in and near the industrial area.

Isotopic breakdown of dose was also affected. The measured dose showed a large (naturally occurring) uranium component that was not seen in the model estimates (see Figure 4-10). The modeled dose, in turn, reflected estimated emissions from projects and from resuspension of soil contaminated with plutonium and americium from the 903 Pad area. The isotopic breakdown of the modeled MEI dose is shown in Figure 4-12. Tritium, which is not shown in Figure 4-12, contributes approximately 0.002% of the maximum EDE.

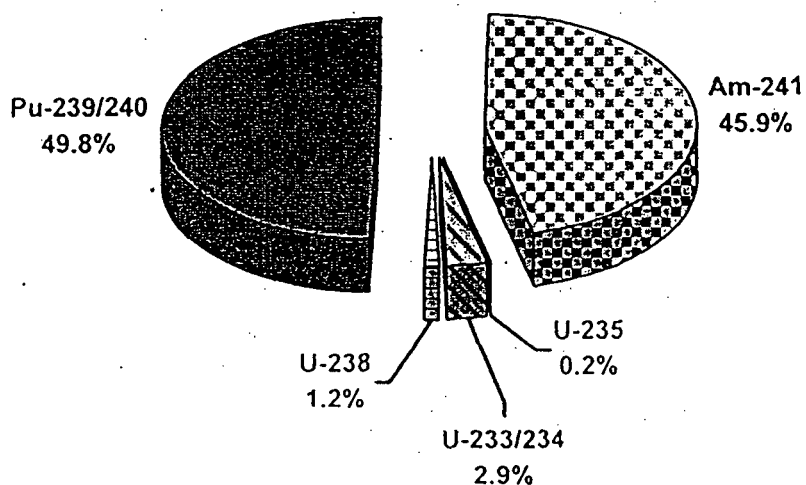


Figure 4-12. Contribution to 1999 Modeled Maximum Off-Site EDE by Isotope

4.3.4 Statement of Compliance Status

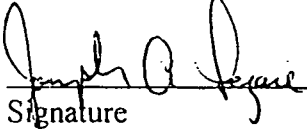
Compliance with the 10 mrem standard has been determined by comparing environmental radionuclide air concentration measurements at critical receptor locations with the "Concentration Levels for Environmental Compliance" listed in Table 2 of Appendix E to 40 CFR 61. Compliance is demonstrated when each measured radionuclide air concentration is less than its corresponding compliance level in Table 2 and when the "fractional sum" of all radionuclides is less than 1. For 1999, each measured radionuclide air concentration was less than 1% of its corresponding compliance level and the fractional sum of all radionuclides was less than 1.5% of the allowable level at all sampling locations. The Site was in compliance with the 10 mrem standard during 1999.

Compliance is demonstrated through emission measurement and modeling when the maximum annual EDE to any member of the public is less than 10 mrem. For 1999, the EDE at the MEI location was 0.004 mrem. Based on this information, the Site was in compliance with the 10 mrem standard during 1999.

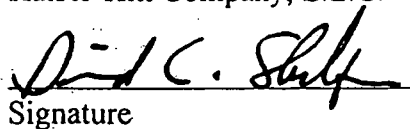
4.4 Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. (See 18 USC 1001.)

Joseph A. Legare
Assistant Manager
for Environment and
Infrastructure


Signature Date 6-19-00

David C. Shelton
Environmental Systems and
Stewardship Manager
Kaiser-Hill Company, L.L.C.


Signature Date 6/13/00

5.0 SUPPLEMENTAL INFORMATION

The following information is provided pursuant to DOE guidance or EPA request and is not required by 40 CFR 61, Subpart H, reporting requirements.

- **Calendar year 1999 dose comparison at various locations:** The maximum EDE to the public for calendar year 1999 calculated through emission estimation and dispersion modeling was 0.004 mrem (0.00004 mSv) for a receptor at a residence located east-southeast of the Site. Annual EDE estimates for the closest receptor locations in other directions from the center of the Site are shown in Table 5-1 for comparison. Information is presented starting at the MEI location to the east-southeast of the Site, then proceeding clockwise around the Site perimeter. Receptor locations are shown in Figure 5-1.

Section 4.3 of this report presents information concerning measured radionuclide concentrations at the "critical receptor" locations. If measured concentrations at the compliance sampling network locations are converted to dose units using the allowable concentrations given in Table 2 of Appendix E to 40 CFR 61 as conversion factors, equivalent EDE values can be calculated at sampler locations. Equivalent EDE values are shown for each of the compliance sampling network locations in Table 5-1. Information is presented starting at the sampler closest to the MEI location (sampler S-138), then proceeding clockwise around the Site perimeter. Sampler locations are shown in Figure 5-1.

Modeling- and measurement-based EDE estimates are compared graphically in Figures 5-2 and 5-3.

- **Calendar year 1999 collective dose:** The collective dose to the surrounding population was calculated with CAP88-PC using population figures that were adjusted from 1994 data based on regional growth information. The collective dose represents the total dose to the surrounding population within 52 miles (83.7 km) of the Site. The collective dose for calendar year 1999 was 0.98 person-rem (0.0098 person-Sv).
- **Other radionuclide regulations:** 40 CFR 61, Subparts T and Q (CAQCC Regulation No. 8, Part A, Subparts T and Q) are not applicable to this Site. Subparts T and Q contain standards for radon emissions from specific facilities.
- **Unplanned releases:** There were no unplanned releases of radionuclides to the atmosphere from the Site during 1999.

**Table 5-1. Calendar Year 1999 EDEs at
Locations Surrounding Site**

Location	1999 EDE (mrem)	Direction to Receptor or Sampler ^a
EDEs Calculated Through Emission Estimation and Modeling		
Mower Reservoir (MEI)	0.004	ESE
96 th and Indiana	0.004	SE
South, at Highway 72	0.002	S
Rocky Flats Lake	0.001	SW
Sawmill, east of Highway 93	0.001	WNW
McCaslin Boulevard	0.003	NE
Northeast Residence	0.004	ENE
East of Great Western Reservoir	0.003	E
Equivalent EDEs Determined Through Sampling		
S-138	0.066	ESE
S-207	0.086	SE
S-139	0.083	SE
S-140 (critical receptor)	0.145	SE
S-141	0.074	S/SSE
S-142	0.070	SSW
S-209	0.084	SW
S-131	0.096	WSW/W
S-132 (critical receptor)	0.145	WNW
S-201	0.086	NW
S-254	0.075	N
S-134	0.055	NNE
S-135	0.106	NE
S-136	0.065	ENE
S-137	0.078	E

^aFrom center of Site industrial area.

Notes:

E	=	East	S	=	South
EDE	=	Effective dose equivalent	SE	=	Southeast
ENE	=	East-northeast	SSE	=	South-southeast
ESE	=	East-southeast	SSW	=	South-southwest
m	=	Meters	SW	=	Southwest
MEI	=	Maximally exposed individual	W	=	West
mrem	=	Millirem	WNW	=	West-northwest
N	=	North	WSW	=	West-southwest
NE	=	Northeast			
NNE	=	North-northeast			
NW	=	Northwest			

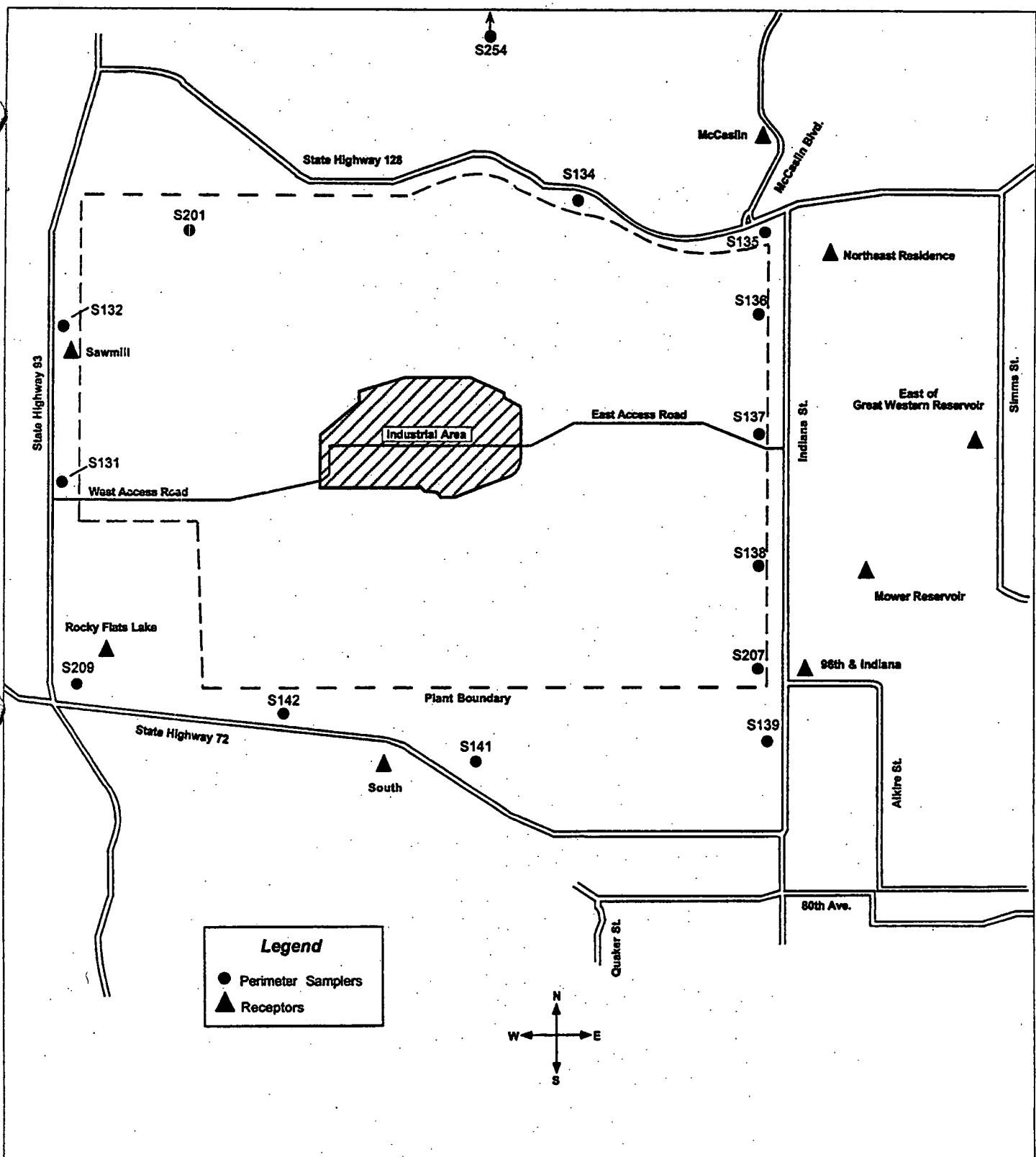


Figure 5-1. Receptor Locations and Nearby Samplers

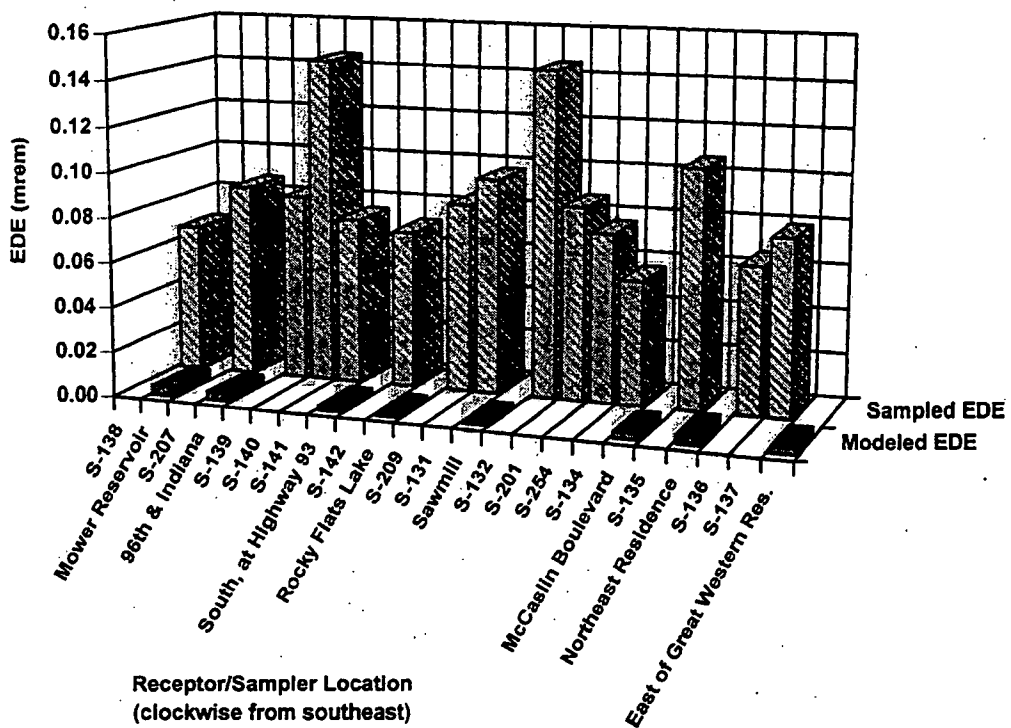


Figure 5-2. Comparison of Modeled and Sampling-Based EDEs at Various Locations

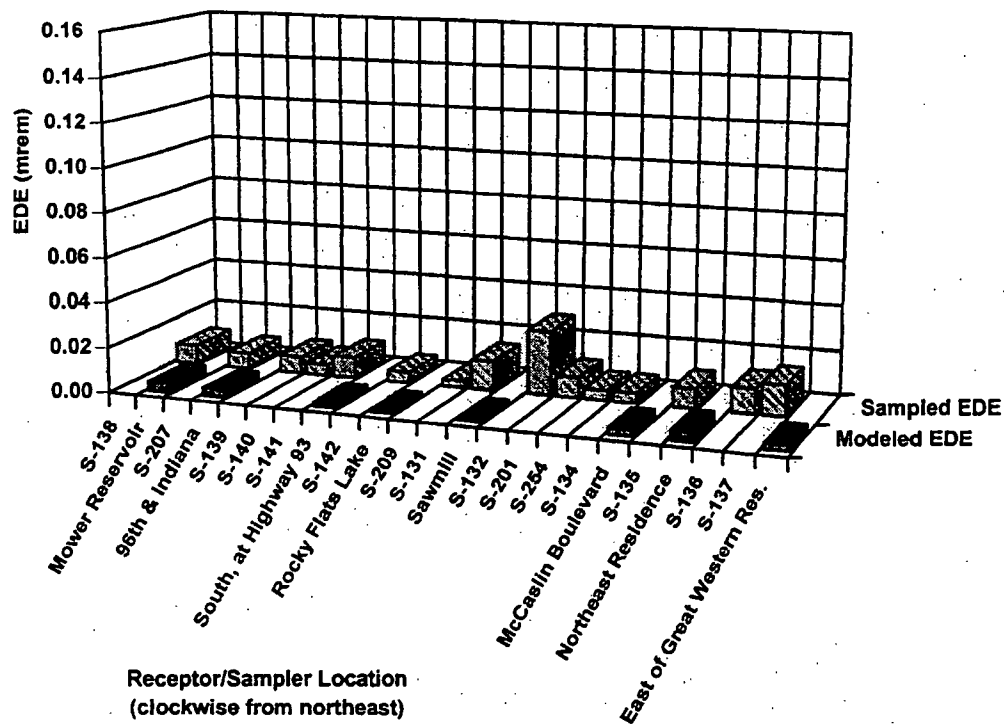


Figure 5-3. Comparison of Modeled and Sampling-Based EDEs for Pu-239/240 and Am-241 at Various Locations

- **Sitewide modeling/environmental measurement data comparison for calendar year 1999:** As discussed previously, the Site has transitioned to an alternative compliance demonstration method for 40 CFR 61, Subpart H, that is based on environmental sampling, rather than emission measurement and modeling. Under the alternative compliance demonstration method, compliance with the 10 mrem (0.1 mSv) annual standard is assessed by comparing concentrations of individual isotopes measured at the Site boundary to compliance levels for each isotope listed in Table 2 of Appendix E to 40 CFR 61 and by summing fractional values of compliance levels for each isotope. Compliance is demonstrated if the measured concentration for each individual isotope is less than the concentration level listed in Table 2 of Appendix E and if the sum of the fractional values is less than 1.

For 1999, several comparisons have been made between the alternative compliance demonstration method and the historical, modeling-based approach. Measured ambient concentrations of various individual isotopes and the summed fractional values of all isotopes are compared in Table 5-2 with the corresponding modeled estimates at the nearest receptor locations. Table 5-2 also shows the measured concentrations and fractional sum at the perimeter samplers with the largest fractional sums in 1999 (i.e., the "critical receptors") and compares those values with the concentrations estimated through modeling for the MEI. Figure 5-1 shows the locations of the perimeter samplers and receptors.

Table 5-2 shows some consistent patterns at all locations. In general, U-233/234 and U-238 concentrations were two to three orders of magnitude higher in the environmental measurement data compared with modeled values. This is consistent with previous years and reflects the contribution of naturally occurring uranium. U-235 was also higher in the environmental measurement data and again may reflect an additional component of natural background.

Other patterns were apparent in the nonuranium isotopes. Pu-239/240 concentrations produced by the modeling analysis were comparable to or less than measured concentrations at all locations. Am-241 concentrations were of the same order of magnitude in both the modeling analysis and measured data at all locations except one. The Am-241 concentration reported at that sampler, S-132, was thought to have been incorrectly recorded due to a possible filter mix up (see below), which may explain why the measured Am-241 concentration exceeded the modeled value at that paired location.

The comparison for these two isotopes is particularly important because it indicates that project emission estimation and modeling, in spite of the generally conservative assumptions made, may not have fully accounted for the plutonium and possibly also americium that were actually measured at the Site fenceline.

Table 5-2. Calendar Year 1999 Measured and Modeled Concentrations

Paired Locations ^a	Isotope	Compliance Level (Ci/m ³)	Measured Concentration (Ci/m ³)	Modeled Concentration (Ci/m ³)
S-137 (Measured) East of Great Western Reservoir (Modeled)	Pu-239	2.0E-15	2.3E-18	4.2E-19
	U-233/234	7.1/7.7E-15	2.4E-17	7.1E-20
	U-235	7.1E-15	1.2E-18	5.3E-21
	U-238	8.3E-15	2.5E-17	3.2E-20
	Am-241	1.9E-15	4.6E-19	2.7E-19
	Fractional Sum	1	0.008	--
S-138 (Measured) Mower Reservoir (Modeled)	Pu-239	2.0E-15	1.4E-18	7.3E-19
	U-233/234	7.1/7.7E-15	2.2E-17	1.1E-19
	U-235	7.1E-15	1.8E-18	8.4E-21
	U-238	8.3E-15	2.0E-17	5.1E-20
	Am-241	1.9E-15	3.2E-19	4.4E-19
	Fractional Sum	1	0.007	--
S-207 (Measured) 96 th and Indiana (Modeled)	Pu-239	2.0E-15	1.1E-18	6.3E-19
	U-233/234	7.1/7.7E-15	3.1E-17	8.3E-20
	U-235	7.1E-15	1.7E-18	6.3E-21
	U-238	8.3E-15	2.8E-17	3.8E-20
	Am-241	1.9E-15	2.8E-19	3.3E-19
	Fractional Sum	1	0.009	--
S-141 (Measured) South, at Highway 72 (Modeled)	Pu-239	2.0E-15	1.6E-18	3.1E-19
	U-233/234	7.1/7.7E-15	2.3E-17	5.3E-20
	U-235	7.1E-15	1.5E-18	4.3E-21
	U-238	8.3E-15	2.5E-17	2.2E-20
	Am-241	1.9E-15	2.6E-19	1.7E-19
	Fractional Sum	1	0.007	--
S-142 (Measured) South, at Highway 72 (Modeled)	Pu-239	2.0E-15	4.6E-19	3.1E-19
	U-233/234	7.1/7.7E-15	2.4E-17	5.3E-20
	U-235	7.1E-15	1.7E-18	4.3E-21
	U-238	8.3E-15	2.5E-17	2.2E-20
	Am-241	1.9E-15	4.7E-19	1.7E-19
	Fractional Sum	1	0.007	--
S-209 (Measured) Rocky Flats Lake (Modeled)	Pu-239	2.0E-15	5.6E-19	1.2E-19
	U-233/234	7.1/7.7E-15	2.9E-17	2.8E-20
	U-235	7.1E-15	1.6E-18	2.2E-21
	U-238	8.3E-15	3.1E-17	1.3E-20
	Am-241	1.9E-15	4.2E-20	9.6E-20
	Fractional Sum	1	0.008	--
S-132 (Measured) Sawmill, east of Highway 93 (Modeled)	Pu-239	2.0E-15	4.4E-18	1.5E-19
	U-233/234	7.1/7.7E-15	4.3E-17	4.0E-20
	U-235	7.1E-15	2.1E-18	3.1E-21
	U-238	8.3E-15	4.4E-17	1.7E-20
	Am-241	1.9E-15	1.2E-18	1.2E-19
	Fractional Sum	1	0.015	--

Table 5-2. (Continued)

Paired Locations^a	Isotope	Compliance Level (Ci/m³)	Measured Concentration (Ci/m³)	Modeled Concentration (Ci/m³)
S-134 (Measured) McCaslin Boulevard (Modeled)	Pu-239	2.0E-15	5.8E-19	4.0E-19
	U-233/234	7.1/7.7E-15	2.0E-17	8.7E-20
	U-235	7.1E-15	1.3E-18	6.5E-21
	U-238	8.3E-15	1.8E-17	4.0E-20
	Am-241	1.9E-15	2.6E-19	3.2E-19
	Fractional Sum	1	0.005	--
S-135 ^c (Measured) McCaslin Boulevard (Modeled)	Pu-239	2.0E-15	9.0E-19	4.0E-19
	U-233/234	7.1/7.7E-15	3.6E-17	8.7E-20
	U-235	7.1E-15	2.3E-18	6.5E-21
	U-238	8.3E-15	3.6E-17	4.0E-20
	Am-241	1.9E-15	7.6E-19	3.2E-19
	Fractional Sum	1	0.011	--
S-136 (Measured) McCaslin Boulevard (Modeled)	Pu-239	2.0E-15	1.7E-18	4.0E-19
	U-233/234	7.1/7.7E-15	2.1E-17	8.7E-20
	U-235	7.1E-15	1.2E-18	6.5E-21
	U-238	8.3E-15	1.9E-17	4.0E-20
	Am-241	1.9E-15	4.2E-19	3.2E-19
	Fractional Sum	1	0.007	--
S-136 (Measured) Northeast Residence (Modeled)	Pu-239	2.0E-15	1.7E-18	6.0E-19
	U-233/234	7.1/7.7E-15	2.1E-17	1.3E-19
	U-235	7.1E-15	1.2E-18	9.5E-21
	U-238	8.3E-15	1.9E-17	6.1E-20
	Am-241	1.9E-15	4.2E-19	4.9E-19
	Fractional Sum	1	0.007	--
Critical Receptor S-140 (Measured) MEI (Modeled)	Pu-239	2.0E-15	4.7E-19	7.3E-19
	U-233/234	7.1/7.7E-15	5.2E-17	1.1E-19
	U-235	7.1E-15	2.7E-18	8.4E-21
	U-238	8.3E-15	5.3E-17	5.1E-20
	Am-241	1.9E-15	4.8E-19	4.4E-19
	Fractional Sum	1	0.015	--
Critical Receptor S-132 (Measured) MEI (Modeled)	Pu-239	2.0E-15	4.4E-18	7.3E-19
	U-233/234	7.1/7.7E-15	4.3E-17	1.1E-19
	U-235	7.1E-15	2.1E-18	8.4E-21
	U-238	8.3E-15	4.4E-17	5.1E-20
	Am-241	1.9E-15	1.2E-18	4.4E-19
	Fractional Sum	1	0.015	--

^aLocations of receptors and samplers are shown in Figure 5-1.

^bCompliance levels are the standards given in Table 2, Appendix E, 40 CFR 61.

^cData represents sampling from September 1, 1999 to January 5, 2000.

Notes:

Am	=	Americium	MEI	=	Maximally exposed individual
CFR	=	Code of Federal Regulations	Pu	=	Plutonium
Ci/m ³	=	Curies per cubic meter	U	=	Uranium
E#	=	x10#	--	=	Not applicable

This reinforces the appropriateness of the environmental measurement-based compliance determination method in situations where nonpoint sources are primary contributors to dose.

If measured concentrations are converted to dose units using the allowable concentrations given in Table 2 of Appendix E to 40 CFR 61 as conversion factors, the maximum dose measured at the perimeter of the Site was approximately 0.145 mrem in 1999. In contrast, the modeled MEI dose was 0.004 mrem. U-233/234 and U-238 isotopes contributed over 90% of the maximum measured dose at S-140 and nearly 80% at S-132, in spite of the suspected filter mixup in February (which would inflate Pu-239/240 and Am-241 values at that location). The uranium isotopes contributed only 4.2% of the modeled dose. Inspection of the U-233/234 to U-238 ratios in the measured data indicate that most of the uranium measured was naturally occurring.

The measured doses due to plutonium and americium isotopes at the critical receptors were approximately 0.02 mrem at S-132 (affected by the suspected data mixup) and 0.005 mrem at S-140. These values may be compared to the total modeled contributions for those isotopes at the MEI location of 0.004 mrem. A comparison of the MEI dose estimate and the equivalent EDE values for the two critical receptors is shown in Figure 5-3.

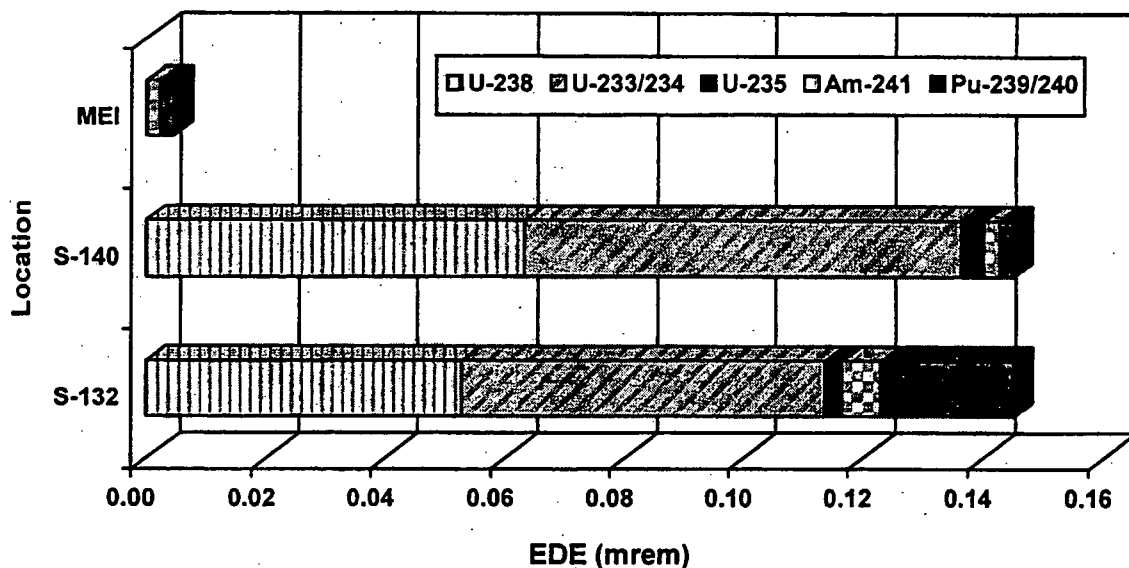


Figure 5-4. Comparison of Maximum Estimated Off-Site Doses Based on Modeling and Environmental Measurement Data

- Tritium Corrections:** Tritium emissions have been reported in previous years in the annual reports prepared for compliance with 40 CFR 61, Subpart H and have been routinely included in the annual estimation of dose to the public. During 1999, several errors were discovered in the prior reporting of tritium emissions. These errors were a result of unit conversion inconsistencies and misreported flow rates through the tritium collection devices. These errors have been corrected; the corrections affect tritium emissions data reported for calendar years 1995 through 1998.

Appendix G shows corrected EIS/ODIS reports for 1995 through 1998. The corresponding changes in input values for CAP88-PC modeling are shown in Table 5-3. Based on the revised input values, tritium contributed less than 1% of the dose to the public in each year from 1995 through 1998. The previously reported MEI doses for these years have not changed due to the corrections in tritium emissions because tritium was such a small contributor to dose.

Table 5-3. Corrected CAP88-PC Input Values for Tritium

Year	Previous Reported Release (Ci)	Revised Release Values (Ci)
1995	6.27	0.0063
1996	6.21	0.0067
1997	0.00511	0.0110
1998	0.0000369	0.0042

Notes:

Ci = Curies

- **Sampler S-132 February Concentrations:** As discussed in Section 4.3.1, the fine fraction data for February 1999 appears to be incorrect for sampler S-132. The results for the February 1999 fine fraction indicate a possible mixup in data from the fiberglass filters for two locations, S-132 and S-107. Sampler S-107, which is not part of the compliance sampling network, is located just to the east of the 903 Pad and routinely shows airborne Pu-239/240 concentrations one to two orders of magnitude higher than the perimeter samplers. During February, the Pu-239/240 concentration reported for S-132 was of the magnitude normally observed at S-107, while the reported S-107 concentration was considerably lower than historical values. These concentrations are uncharacteristic for these locations.

The coarse fraction, which is collected on a separate filter pad, did not show the same pattern as the fine fraction data in February; instead, coarse fraction concentrations appeared similar to historical values for these two locations. In addition, there was no known releases on Site during February that would have led to the Pu-239/240 concentrations reported for S-132. However, because the probable error could not be confirmed, Pu-239/240 (and other radionuclide) data have been used in this annual report as received from the laboratory.

For comparison, the S-132 annual concentration data have also been revised to include the February data reported for S-107 for the fine fraction (i.e., to show the data that are believed to be correct for that location). The change in concentrations that would result is shown graphically in Figure 5-4. The data for the critical receptor location to the southeast of the Site (S-140) is shown for comparison. The corresponding concentration values converted to dose units are shown in Figure 5-5.

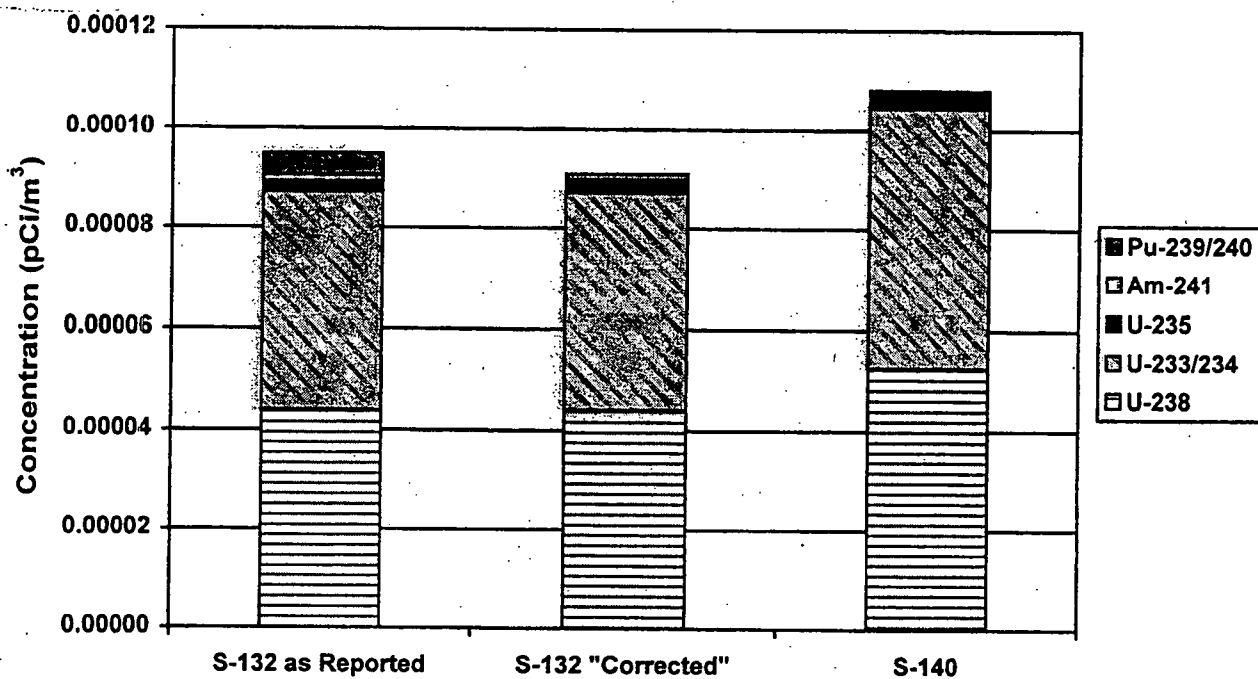


Figure 5-5. Measured Annual Radionuclide Concentrations at the Critical Receptors

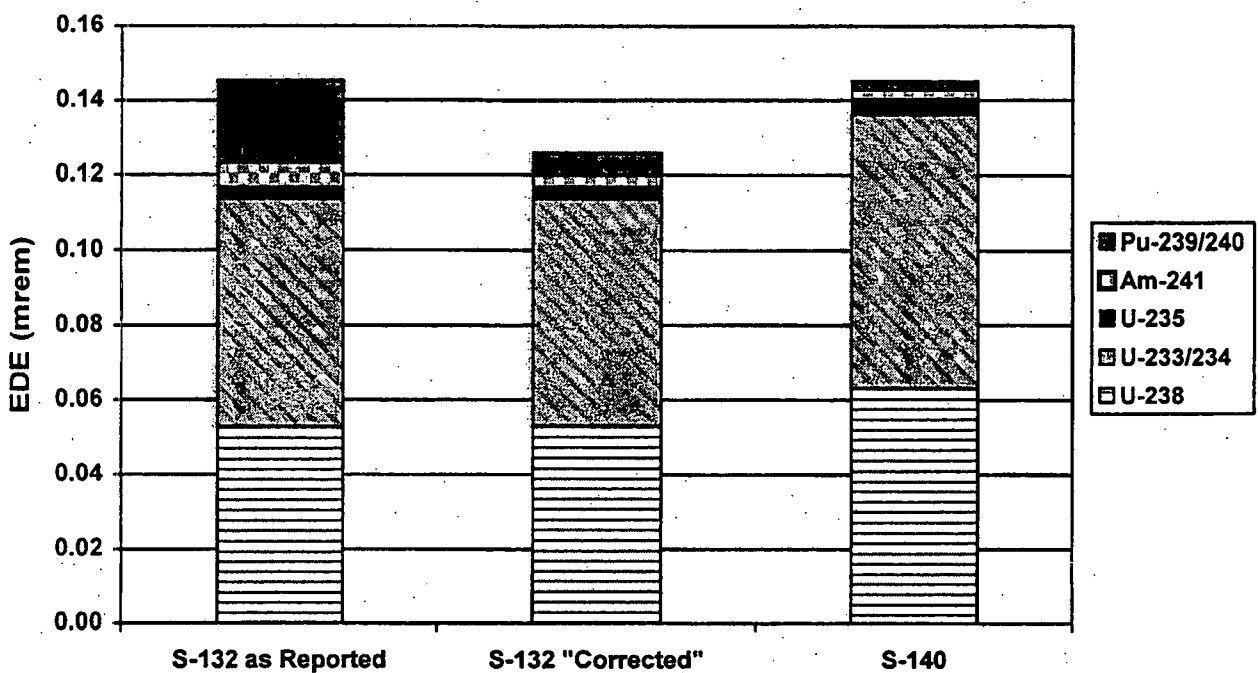


Figure 5-6. Equivalent EDEs Based on Measured Annual Radionuclide Concentrations at the Critical Receptors

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Appendix A

Radioactive Materials Associated with Rocky Flats

ROCKY FLATS HEALTH PHYSICS REPORT
RADIOACTIVE MATERIALS
ASSOCIATED WITH
ROCKY FLATS

October 31, 1995

B. Britton
Source Registry Program Administrator
303/966-8452

A. RADIOACTIVE MATERIALS HANDLED IN KILOGRAM QUANTITIES

1. Plutonium

Isotopic Composition of Rocky Flats Plutonium

<u>Isotope</u>	<u>Relative Weight (percent)</u>	<u>Specific Alpha Activity (Curies/gram)</u>	<u>Specific Beta Activity (Curies/gram)</u>	<u>Relative Activity (Curies/gram)^a</u>
Pu-238	0.01	17.01	—	0.00171
Pu-239	93.79	0.0622	—	0.05834
Pu-240	5.80	0.228	—	0.01322
Pu-241	0.36	—	103.5	0.37260
Pu-242	0.03	0.00393	—	1.18x10 ⁻⁶
Am-241	^b	3.42	—	—

^a Relative activity is obtained by multiplying the percent by weight by the specific activity. The total activity for the Plutonium Isotopes is: Alpha, 0.0732 curies/gram; and Alpha plus Beta, 0.446 curies/gram.

^b Am-241 is a radioactive decay product of Pu-241.

2. Enriched Uranium

Common Name: Oralloy

Normal Isotopic Composition: >90% U-235

3. Depleted Uranium

Common Names: Tuballoy, D-38, U-238

Normal Isotopic Composition: <0.71% U-235

4. Americium (Am-241)

Am-241 is a radioactive decay product of Pu-241.

5. Natural Uranium (Thorium and Uranium-233)

Rocky Flats has both the capability and potential to handle these in kilogram quantities. Some of these materials have been handled in the past.

B. RADIOACTIVE MATERIALS HANDLED IN GRAM QUANTITIES (<1Kg)

Curium-244
Neptunium-237
Uranium-233
Plutonium-238,-242

These radioisotopes may be handled at Rocky Flats primarily for research and analytical activities.

C. RADIOISOTOPES UTILIZED AT ROCKY FLATS AS REGISTERED AND/OR MISCELLANEOUS SOURCES

1. Registered Sources (Twice-Yearly Leak Test and Physical Audit)

Sealed solids >10 μ Ci
Plated solids >1 μ Ci
Liquids > 10^{-3} μ Ci

Americium	(Am-241)	Iridium	(Ir-192)
Antimony	(Sb-124)	Iron	(Fe-55)
Barium	(Ba-133)	Nickel	(Ni-63)
Cadmium	(Cd-109)	Plutonium	(Pu-238,-239, -240,-244)
Californium	(Cf-252)	Promethium	(Pm-147)
Cesium	(Cs-137)	Radium	(Ra-226)
Cobalt	(Co-57,60)	Selenium	(Se-75)
Europium	(Eu-152)	Sodium	(Na-22)
Hydrogen (Tritium)	(H-3)	Strontium	(Sr-90)
		Thorium	(Th-228)
		Uranium	(U-234,-235,-238)

2. Miscellaneous Sources

Sealed solids < 10 μ Ci
Plated solids < 1 μ Ci
Liquids < 10^{-3} μ Ci
Analytical stock solutions

Alumium	(Al-26)
Americium	(Am-241,243)
Antimony	(Sb-125)
Argon	(Ar-39)
Barium	(Ba-133)
Beryllium	(Be-7)
Bismuth	(Bi-207,-210)
Cadmium	(Cd-109)
Californium	(Cf-252)
Carbon	(C-14)
Cesium	(Cs-137)
Chlorine	(Cl-36)
Cobalt	(Co-57,-60)
Curium	(Cm-244)
Europium	(Eu-152)
Holmium	(Ho-166m)
Hydrogen (Tritium)	(H-3)
Iodine	(I-129,-131)
Iron	(Fe-55)
Krypton	(Kr-85)
Lead	(Pb-210)
Manganese	(Mn-54)
Mercury	(Hg-203)

Neptunium	(Np-237)
Plutonium	(Pu-236,-238,-239 -240,241,242)
Polonium	(Po-210)
Promethium	(Pm-147)
Radium	(Ra-226)
Ruthenium	(Ru-106)
Selenium	(Se-75)
Silver	(Ag-110m)
Sodium	(Na-22)
Strontium	(Sr86-90)
Technetium	(Tc-99m)
Thallium	(Tl-204)
Thorium	(Th-228,-230,-232)
Tin	(Sn-113)
Uranium	(U-232, -234, 235, -236,-238)
Yttrium	(Y-88,-90)
Zinc	(Zn-65)

D. RADIUM SOURCES HANDLED AND STORED AT ROCKY FLATS

<u>AS/RS*</u>	<u>EG&G ID</u>	<u>Nuclide</u>	<u>Location</u>	<u>Original Activity (μCi)</u>
AS	2934	Ra-226	119	0.09
RS	100	Ra-226	707	6.00000
RS	138	Ra-226	776	6.00000
RS	3695	Ra-226	881	6.26
RS	866	Ra-226	881	10.95
RS	810	Ra-226	771	11.26000
RS	409	Ra-226	371	12.5
RS	196	Ra-226	771	16
RS	23	Ra-226	777	4500
RS	146	Ra-226	777	4500

* AS = Accountable Source
RS = Registered Source

Appendix B

Calendar Year 1999 Effluent Release Points

**Release Points
CY 1999**

Building/ Location	Number of Release Points	Significant (S) or Insignificant (I)	Notes
371-N01	1	S	
371-N02	1	S	
371-SSS	1	S	
374-MAI	1	S	
374-SPD	1	I	
440-101	1	S	New emission point - sampling started on 3/15/99.
444-D05	1	I	
444-MAI	1	I	
447-MAI	1	I	
559-561	1	S	
707-101/103	1	S	
707-102/104	1	S	
707-105	1	S	
707-106	1	S	
707-107	1	S	
707-108	1	S	
707-R21A/B	2	I	Sampling discontinued 1/12/00 due to alternative compliance method.
707-R22A/B	2	I	Sampling discontinued 1/12/00 due to alternative compliance method.
707-R23A/B	2	I	Sampling discontinued 1/12/00 due to alternative compliance method.
707-R24A/B	2	I	Sampling discontinued 1/12/00 due to alternative compliance method.
707-R25A/B	2	I	Sampling discontinued 1/12/00 due to alternative compliance method.
707-R26A/B	2	I	Sampling discontinued 1/12/00 due to alternative compliance method.
707-R27A/B	2	I	Sampling discontinued 1/12/00 due to alternative compliance method.
707-R45A/B	2	I	Sampling discontinued 1/12/00 due to alternative compliance method.
707-R46A/B	2	I	Sampling discontinued 1/12/00 due to alternative compliance method.
771-CMA	1	I	Sampling discontinued 1/17/00 due to alternative compliance method.
771-CRM	1	I	Sampling discontinued 1/17/00 due to alternative compliance method.

(Continued)

771-MAI	1	S	
774-202	1	S	
776-201	1	S	776-201, -204, & -250 vent into a penthouse, but are still considered 3 emission points.
776-202	1	I	
776-204	1	S	776-201, -204, & -250 vent into a penthouse, but are still considered 3 emission points.
776-205	1	S	
776-250	1	I	776-201, -204, & -250 vent into a penthouse, but are still considered 3 emission points.
776-251	1	I	
776-252	1	I	
779-404	1	I	D&D activities made sampling not possible after 4/27/99.
779-729	1	S	D&D activities made sampling not possible after 3/16/99.
779-782	1	S	D&D activities made sampling not possible after 8/2/99.
865-EEE	1	I	Sampling discontinued 10/5/99 due to alternative compliance method.
865-WWW	1	I	Sampling discontinued 10/5/99 due to alternative compliance method.
881-MA1	1	I	Sampling discontinued 1/4/00 due to alternative compliance method.
881-MA2	1	I	Sampling discontinued 1/4/00 due to alternative compliance method.
881-MA3	1	I	Sampling discontinued 1/4/00 due to alternative compliance method.
881-MA4	1	I	Sampling discontinued 1/4/00 due to alternative compliance method.
883-AAA	1	I	Sampling discontinued 10/5/99 due to alternative compliance method.
883-BBB	1	I	Sampling discontinued 10/5/99 due to alternative compliance method.
883-CCC	1	I	Sampling discontinued 10/5/99 due to alternative compliance method.
886-875	1	I	Sampling discontinued 5/20/99 due to D&D activities.
Total	58		

Notes:

CY = Calendar year

D & D = Deactivation and demolition

Appendix C

Effluent Information System (EIS) Data 1999

Summary Table For The EIS/ODIS Report^a
1999-Release

99_ODIS Location	ODIS Location Code	N	Effluent Volume (m ³)	Plutonium-239 (Ci)	Americium-241 ^c (Ci)	Uranium-233/234 (Ci)	Uranium-235 (Ci)	Uranium-238 (Ci)	Tritium (Ci)
707-101	AFGHB707005	12	7.882E+06	6.449E-11	4.330E-11	1.900E-10	6.979E-11	9.219E-11	--
707-102	AFGHB707006	12	2.117E+07	2.505E-10	1.482E-10	5.526E-10	3.264E-10	3.028E-10	--
707-105	AFGHB707003	12	8.003E+07	1.201E-10	2.796E-10	4.048E-09	8.899E-10	1.870E-09	--
707-106	AFGHB707001	12	3.372E+07	7.077E-10	3.615E-10	9.387E-10	5.904E-10	7.316E-10	--
707-107	AFGHB707004	12	1.848E+08	2.450E-08	3.921E-09	1.388E-08	2.738E-09	1.130E-08	---
707-108	AFGHB707002	12	1.055E+08	1.210E-09	7.637E-10	1.012E-09	1.474E-09	2.817E-09	--
707-R21	AFGHI707001	1	4.453E+08	3.341E-10	-6.344E-11	-2.719E-09	-4.694E-10	-1.764E-09	--
707-R22	AFGHI707002	1	4.453E+08	5.878E-09	1.049E-09	-4.483E-10	-8.966E-10	3.087E-10	--
707-R23	AFGHI707003	1	4.453E+08	2.839E-09	9.596E-10	5.109E-10	-1.777E-10	2.754E-10	--
707-R24	AFGHI707004	1	4.453E+08	1.226E-10	-2.368E-10	-2.034E-09	-7.570E-10	2.296E-09	--
707-R25	AFGHI707005	1	4.453E+08	3.552E-10	-2.115E-11	-2.622E-10	-3.383E-10	-3.307E-09	--
707-R26	AFGHI707006	1	4.453E+08	5.709E-10	-2.368E-10	-4.225E-09	3.722E-10	-6.200E-09	--
707-R27	AFGHI707007	1	4.453E+08	-1.057E-10	-4.102E-10	-3.011E-09	-3.510E-10	-3.193E-09	-
707-R45	AFGHI707008	1	4.453E+08	7.570E-10	-2.115E-10	-1.916E-09	-8.460E-12	-8.881E-10	--
707-R46	AFGHI707009	1	4.453E+08	7.020E-10	-2.115E-10	-2.343E-09	-2.960E-11	-1.235E-09	--
779-782	AFGHF779002	7	3.628E+08	3.962E-09	1.808E-09	1.634E-08	1.570E-09	1.251E-08	--
779-729	AFGHF779001	3	3.938E+06	1.354E-10	8.128E-11	-7.739E-11	5.140E-11	-4.811E-11	--
776-201	AFGHE776003	12	6.380E+06	1.259E-11	5.474E-11	2.519E-10	7.650E-11	1.146E-10	--
776-202	AFGHE776008	12	7.276E+07	4.396E-10	-6.170E-12	-8.484E-11	7.404E-11	-7.558E-11	--
776-204	AFGHE776005	12	1.630E+08	2.836E-09	1.083E-09	1.562E-09	2.097E-09	3.648E-09	--
776-205 ^b	--	12	2.234E+08	1.020E-09	1.325E-09	5.862E-09	2.646E-09	5.304E-09	--
776-205T ^c	AFGHE776004	--	--	--	--	--	--	--	1.489E-04
776-206T ^c	AFGHE776002	--	--	--	--	--	--	--	8.477E-04
776-250	AFGHE776001	1	3.923E+08	3.999E-09	-7.788E-10	1.642E-08	-2.105E-11	-2.362E-08	3.662E-04
776-251	AFGHE776006	1	3.282E+08	3.534E-10	-1.401E-10	-2.964E-09	-2.451E-10	1.283E-09	1.115E-04
776-252	AFGHE776007	1	8.684E+07	6.212E-10	2.105E-10	-1.838E-09	-1.061E-10	-2.005E-09	--
559-561	AFGHA559001	12	5.853E+08	5.314E-09	5.363E-09	9.455E-09	5.118E-09	1.878E-08	--
778-LDY	AFGHH778001	0	--	--	--	--	--	--	--

(Continued)									
771-MAI	AFGHC771001	12	2.680E+09	1.769E-08	1.963E-08	1.252E-07	2.309E-08	5.094E-08	--
771-CMA	AFGHC771002	1	6.978E+07	1.196E-08	3.067E-10	-5.426E-10	-3.286E-11	-5.595E-10	--
771-CRM	AFGHC771005	1	8.486E+07	6.939E-10	2.198E-09	8.101E-10	2.002E-10	-2.693E-10	--
774-202	AFGHD774001	12	9.209E+07	5.168E-10	4.913E-10	4.564E-09	7.892E-10	2.629E-09	--
444-MAI	AFGHN444004	1	1.268E+09	-1.587E-10	-3.174E-11	-1.396E-08	-5.819E-10	-1.179E-08	--
444-DO5	AFGHN444003	1	1.480E+08	8.311E-11	-1.691E-10	-1.937E-09	3.468E-10	-1.814E-09	--
447-MAI	AFGHO447001	1	7.119E+08	-6.610E-11	-1.675E-10	-9.008E-09	-5.817E-10	-7.276E-09	--
865-EEE	AFGHP865001	1	3.069E+08	1.667E-10	-1.228E-10	-8.518E-09	-7.895E-11	-9.426E-09	--
865-WWW	AFGHP865002	1	5.086E+08	6.975E-10	-5.565E-10	-1.367E-08	2.586E-10	-1.695E-08	--
886-875	AFGHS886001	5	4.322E+07	2.824E-10	4.891E-10	1.460E-09	2.448E-10	1.000E-09	--
881-ANX	AFGHQ881002	0	--	--	--	--	--	--	--
881-MAI	AFGHQ881001	4	3.923E+09	3.715E-09	-9.393E-10	-3.883E-08	-3.339E-09	-2.980E-08	--
883-AAA	AFGHR883001	1	1.727E-09	-3.949E-10	-1.264E-08	-1.071E-09	-1.293E-08	-3.748E-10	--
883-BBB	AFGHR883002	1	6.632E-10	-2.345E-10	-1.037E-08	-4.689E-11	-1.347E-09	-1.876E-09	--
883-CCC	AFGHR883003	1	3.804E-10	-1.630E-10	-7.184E-09	5.434E-11	-5.847E-09	5.978E-11	--
889-MAI	AFGHT889001	0	--	--	--	--	--	--	--
991-985	AFGHU991001	0	--	--	--	--	--	--	--
374-MAI	AFGHJ374001	12	3.120E+08	2.301E-09	1.537E-09	1.165E-08	3.334E-09	1.155E-08	--
991-MAI	AFGHU991002	0	--	--	--	--	--	--	--
371-NNN	AFGHC371001	24	4.494E+08	2.239E-08	5.564E-09	1.997E-08	6.103E-09	9.965E-09	--
371-SSS	AFGHC371002	12	3.132E+08	3.481E-09	3.769E-10	3.592E-09	6.776E-10	1.352E-09	--
374-SPD	AFGHD374002	1	8.737E+07	1.772E-09	2.341E-09	-3.205E-10	-9.515E-11	1.840E-10	--
779-404	--	4	1.359E+08	4.916E-09	4.183E-09	7.760E-10	1.025E-09	3.824E-09	--
440-101 ^d	--	10	3.911E+07	1.364E-10	2.229E-10	7.613E-10	6.023E-10	1.447E-09	--
RFETS		250	1.780E+10	1.267E-07	2.007E-08	1.293E-07	2.593E-08	2.067E-08	1.474E-03

^a No longer report Pu-238.

^b Release points 776-205, -206, and -207 are combined through a mixing plenum and are sampled with one shrouded probe identified as 776-205.

^c The tritium sampling occurs before the mixing plenum described in footnote b. The location names have been altered to denote them as tritium sampling points.

^d Location 440-101 is a new release point for 1999.

Notes:

Ci	=	Curies
EIS	=	Effluent Information System
m ³	=	Cubic meters
N	=	Number of filters analyzed
ODIS	=	Off-Site Discharge Information System
RFETS	=	Rocky Flats Environmental Technology Site
--	=	Not analyzed

Appendix D
Stack Data for Point Sources

Stack Data for Point Sources

Building/ Location	Height (m)	Diameter (m)	Width (m)	Length (m)	Volumetric Flowrate (m ³ /s)	Stack Type	Vent No.
371-SSS	16.00	-	1.54	5.76	13.61	Penthouse	2
371-NO1 ^a	16.00	1.22	-	-	7.10	Penthouse	1
371-NO2 ^a	16.00	1.22	-	-	7.18	Penthouse	1
374-MAI	23.77	-	1.83	1.37	9.68	Penthouse	7, 8, 9
374-SPD	9.14	0.42	-	-	2.78	90°	3
440-101	13.46	0.51	-	-	1.62	Open	1
444-D05	3.56	-	0.76	0.61	5.01	90°	122
444-MAI	5.90	-	2.74	2.44	42.90	90°	200
447-MAI	4.00	-	1.83	1.52	24.09	90°	201
559-561	7.00	-	2.29	1.52	19.53	Mixing Box	36
707-101/103 ^b	11.33	-	0.46	0.30	0.25	Mixing Box	36
707-102/104 ^c	11.33	-	1.37	0.91	0.71	Mixing Box	9, 10
707-105	11.33	-	1.37	0.91	2.54	Mixing Box	28
707-106	11.33	-	0.91	0.61	1.13	Mixing Box	55
707-107	11.33	-	1.60	1.07	5.92	Mixing Box	65
707-108	11.33	-	1.37	0.91	3.36	Mixing Box	75
707-R21A	13.70	1.10	-	-	7.08	Open	38
707-R21B	13.70	1.10	-	-	7.08	Open	39
707-R22A	13.70	1.10	-	-	7.08	Open	40
707-R22B	13.70	1.10	-	-	7.08	Open	41
707-R23A	13.70	1.10	-	-	7.08	Open	42
707-R23B	13.70	1.10	-	-	7.08	Open	43
707-R24A	13.70	1.10	-	-	7.08	Open	44
707-R24B	13.70	1.10	-	-	7.08	Open	45
707-R25A	13.70	1.10	-	-	7.08	Open	76
707-R25B	13.70	1.10	-	-	7.08	Open	77
707-R26A	13.70	1.10	-	-	7.08	Open	78
707-R26B	13.70	1.10	-	-	7.08	Open	79
707-R27A	13.70	1.10	-	-	7.08	Open	80
707-R27B	13.70	1.10	-	-	7.08	Open	81
707-R45A	13.00	0.84	-	-	7.08	Open	1
707-R45B	12.86	0.84	-	-	7.08	Open	2

(Continued)

Building/ Location	Height (m)	Diameter (m)	Width (m)	Length (m)	Volumetric Flowrate (m ³ /s)	Stack Type	Vent No.
707-R46A	12.86	0.81	-	-	7.08	Open	3
707-R46B	12.86	0.81	-	-	7.08	Open	4
771-CMA	7.67	0.61	-	-	2.22	Gooseneck	9
771-CRM8	7.82	0.45	-	-	1.93	90°	1
771-CRM10	7.25	-	0.61	0.51	0.77	90°	8
771-MAI	50.14	3.12	-	-	85.16	Open	86
774-202	7.11	-	0.91	0.61	2.96	Mixing Box	4
776-201 ^d	12.00	0.35	-	-	0.21	Penthouse	24
776-202	16.10	0.52	-	-	1.99	Rain Cap	17
776-204 ^d	12.00	-	1.83	0.61	5.19	Penthouse	24
776-205/206/207 ^c	12.00	-	1.6	1.07	7.18	Mixing Box	32
776-250 ^d	12.00	-	4.88	1.62	11.36	Penthouse	24
776-251	13.00	-	0.81	1.52	10.43	Wall penetration	45
776-252	13.20	-	0.91	0.56	2.76	90° Wall penetration	44
779-729 ⁱ	26.82	0.96	-	-	4.63	Open	12
779-782 ^g	6.70	-	0.91	1.45	20.07	Gooseneck	1
779-404 ^h	9.30	-	0.94	2.44	12.95	90°	70
779-405 ^h	17.68	0.97	-	-	83.17	Open	22
790	*	*	*	*	*	*	*
865-EEE ⁱ	5.66	-	1.12	1.52	13.01	90°	63,64
865-WWW ⁱ	5.30	-	1.42	1.42	21.56	90°	58,59
881-MA1	12.40	2.44	-	-	26.41	Open	8
881-MA2	12.40	2.44	-	-	52.02	Open	7
881-MA3	12.40	2.44	-	-	24.68	Open	5
881-MA4	12.40	2.44	-	-	21.62	Open	6
883-AAA ⁱ	7.41	-	1.32	2.50	24.76	90°	44
883-BBB ⁱ	7.07	-	1.32	2.50	34.53	90°	45
883-CCC ^j	21.43	1.22	-	-	7.49	Open	34
886-875 ^j	5.95	-	1.22	0.61	3.70	Gooseneck	15

- ^a 371-N01/N02 combined to one penthouse.
^b 707-101/103 combined into one stack.
^c 707-102/104 combined into one stack.
^d 776-201/204/250 combined to penthouse vent No. 24.
^e 776-205/206/207 combined to penthouse vent No. 32.
^f Sampler turned off March 1, 1999.
^g Sampler turned off August 2, 1999.
^h Sampler turned off April 27, 1999.
ⁱ Sampler turned off October 5, 1999.
^j Sampler turned off May 20, 1999.

Notes:

m	=	Meters
m ³ /s	=	Cubic meters per second
*	=	Data not available
-	=	Not applicable

Appendix E
Meteorological Data Set

Meteorological Data Set

Wind Direction	Stability Class	1.0 to 1.8 (m/s)	1.8 to 3.3 (m/s)	3.3 to 5.4 (m/s)	5.4 to 8.5 (m/s)	8.5 to 11.0 (m/s)	>11.0 (m/s)	Cumulative Fraction by Direction
N	A	0.002	0.004	0.000	0.000	0.000	0.000	0.006
NNE	A	0.003	0.009	0.000	0.000	0.000	0.000	0.012
NE	A	0.004	0.008	0.000	0.000	0.000	0.000	0.012
ENE	A	0.004	0.009	0.000	0.000	0.000	0.000	0.013
E	A	0.004	0.009	0.000	0.000	0.000	0.000	0.014
ESE	A	0.006	0.015	0.000	0.000	0.000	0.000	0.021
SE	A	0.003	0.012	0.000	0.000	0.000	0.000	0.015
SSE	A	0.002	0.004	0.000	0.000	0.000	0.000	0.006
S	A	0.001	0.002	0.000	0.000	0.000	0.000	0.003
SSW	A	0.001	0.001	0.000	0.000	0.000	0.000	0.003
SW	A	0.001	0.001	0.000	0.000	0.000	0.000	0.002
WSW	A	0.001	0.001	0.000	0.000	0.000	0.000	0.002
W	A	0.001	0.001	0.000	0.000	0.000	0.000	0.003
WNW	A	0.001	0.001	0.000	0.000	0.000	0.000	0.003
NW	A	0.001	0.002	0.000	0.000	0.000	0.000	0.003
NNW	A	0.002	0.002	0.000	0.000	0.000	0.000	0.004
N	B	0.000	0.004	0.003	0.000	0.000	0.000	0.007
NNE	B	0.000	0.004	0.003	0.000	0.000	0.000	0.008
NE	B	0.000	0.004	0.003	0.000	0.000	0.000	0.007
ENE	B	0.000	0.003	0.002	0.000	0.000	0.000	0.005
E	B	0.000	0.002	0.004	0.000	0.000	0.000	0.007
ESE	B	0.001	0.005	0.004	0.000	0.000	0.000	0.011
SE	B	0.000	0.006	0.003	0.000	0.000	0.000	0.010
SSE	B	0.000	0.003	0.001	0.000	0.000	0.000	0.004
S	B	0.000	0.001	0.000	0.000	0.000	0.000	0.002
SSW	B	0.000	0.001	0.000	0.000	0.000	0.000	0.002
SW	B	0.000	0.001	0.000	0.000	0.000	0.000	0.001
WSW	B	0.000	0.000	0.000	0.000	0.000	0.000	0.001
W	B	0.000	0.001	0.000	0.000	0.000	0.000	0.001
WNW	B	0.000	0.001	0.001	0.000	0.000	0.000	0.002
NW	B	0.000	0.001	0.001	0.000	0.000	0.000	0.002
NNW	B	0.000	0.002	0.001	0.000	0.000	0.000	0.004
N	C	0.001	0.004	0.009	0.002	0.000	0.000	0.015
NNE	C	0.000	0.002	0.004	0.001	0.000	0.000	0.007
NE	C	0.000	0.001	0.002	0.000	0.000	0.000	0.004
ENE	C	0.000	0.001	0.002	0.000	0.000	0.000	0.003
E	C	0.000	0.002	0.002	0.000	0.000	0.000	0.004
ESE	C	0.000	0.002	0.003	0.000	0.000	0.000	0.005
SE	C	0.000	0.004	0.006	0.001	0.000	0.000	0.011
SSE	C	0.000	0.004	0.007	0.001	0.000	0.000	0.012
S	C	0.000	0.002	0.002	0.000	0.000	0.000	0.004

(Continued)

Wind Direction	Stability Class	1.0 to 1.8 (m/s)	1.8 to 3.3 (m/s)	3.3 to 5.4 (m/s)	5.4 to 8.5 (m/s)	8.5 to 11.0 (m/s)	>11.0 (m/s)	Cumulative Fraction by Direction
SSW	C	0.000	0.001	0.002	0.001	0.000	0.000	0.003
SW	C	0.000	0.001	0.001	0.000	0.000	0.000	0.002
WSW	C	0.000	0.000	0.002	0.000	0.000	0.000	0.003
W	C	0.000	0.001	0.002	0.001	0.000	0.000	0.004
WNW	C	0.000	0.001	0.003	0.002	0.000	0.000	0.007
NW	C	0.000	0.001	0.002	0.001	0.000	0.000	0.004
NNW	C	0.000	0.002	0.004	0.001	0.000	0.000	0.007
N	D	0.000	0.006	0.009	0.006	0.001	0.000	0.023
NNE	D	0.000	0.005	0.007	0.004	0.001	0.000	0.017
NE	D	0.000	0.003	0.003	0.001	0.000	0.000	0.007
ENE	D	0.000	0.003	0.002	0.000	0.000	0.000	0.005
E	D	0.000	0.003	0.001	0.000	0.000	0.000	0.004
ESE	D	0.000	0.002	0.002	0.000	0.000	0.000	0.004
SE	D	0.000	0.004	0.004	0.002	0.000	0.000	0.011
SSE	D	0.000	0.005	0.011	0.004	0.001	0.000	0.021
S	D	0.000	0.009	0.012	0.003	0.000	0.000	0.025
SSW	D	0.001	0.009	0.010	0.003	0.000	0.000	0.023
SW	D	0.000	0.009	0.013	0.004	0.001	0.000	0.028
WSW	D	0.001	0.011	0.014	0.012	0.004	0.002	0.044
W	D	0.001	0.014	0.016	0.018	0.009	0.013	0.071
WNW	D	0.000	0.009	0.015	0.033	0.019	0.022	0.098
NW	D	0.000	0.010	0.011	0.011	0.004	0.002	0.038
NNW	D	0.001	0.010	0.016	0.008	0.000	0.000	0.035
N	E	0.001	0.003	0.000	0.000	0.000	0.000	0.004
NNE	E	0.000	0.001	0.001	0.000	0.000	0.000	0.002
NE	E	0.000	0.001	0.000	0.000	0.000	0.000	0.002
ENE	E	0.000	0.001	0.000	0.000	0.000	0.000	0.001
E	E	0.000	0.001	0.000	0.000	0.000	0.000	0.001
ESE	E	0.000	0.001	0.000	0.000	0.000	0.000	0.002
SE	E	0.000	0.002	0.000	0.000	0.000	0.000	0.003
SSE	E	0.001	0.003	0.002	0.000	0.000	0.000	0.005
S	E	0.001	0.005	0.005	0.000	0.000	0.000	0.011
SSW	E	0.001	0.005	0.006	0.000	0.000	0.000	0.011
SW	E	0.001	0.009	0.010	0.000	0.000	0.000	0.019
WSW	E	0.001	0.010	0.014	0.000	0.000	0.000	0.025
W	E	0.001	0.011	0.003	0.000	0.000	0.000	0.016
WNW	E	0.002	0.008	0.003	0.000	0.000	0.000	0.013
NW	E	0.000	0.006	0.005	0.000	0.000	0.000	0.011
NNW	E	0.001	0.004	0.006	0.000	0.000	0.000	0.010
N	F	0.003	0.003	0.000	0.000	0.000	0.000	0.005
NNE	F	0.003	0.002	0.000	0.000	0.000	0.000	0.004
NE	F	0.001	0.001	0.000	0.000	0.000	0.000	0.003

(Continued)

Wind Direction	Stability Class	1.0 to 1.8 (m/s)	1.8 to 3.3 (m/s)	3.3 to 5.4 (m/s)	5.4 to 8.5 (m/s)	8.5 to 11.0 (m/s)	>11.0 (m/s)	Cumulative Fraction by Direction
ENE	F	0.001	0.002	0.000	0.000	0.000	0.000	0.003
E	F	0.001	0.002	0.000	0.000	0.000	0.000	0.003
ESE	F	0.002	0.002	0.000	0.000	0.000	0.000	0.004
SE	F	0.002	0.002	0.000	0.000	0.000	0.000	0.004
SSE	F	0.003	0.004	0.000	0.000	0.000	0.000	0.008
S	F	0.003	0.005	0.000	0.000	0.000	0.000	0.009
SSW	F	0.004	0.006	0.000	0.000	0.000	0.000	0.010
SW	F	0.004	0.006	0.000	0.000	0.000	0.000	0.011
WSW	F	0.004	0.007	0.000	0.000	0.000	0.000	0.011
W	F	0.005	0.007	0.000	0.000	0.000	0.000	0.012
WNW	F	0.006	0.005	0.000	0.000	0.000	0.000	0.012
NW	F	0.005	0.005	0.000	0.000	0.000	0.000	0.010
NNW	F	0.004	0.004	0.000	0.000	0.000	0.000	0.008
Cumulative Fraction by Wind Speed Class		0.116	0.399	0.283	0.123	0.040	0.040	1.000

Notes:

E = East
 ENE = East-northeast
 ESE = East-southeast
 m/s = meters per second
 N = North
 NE = Northeast
 NNE = North-northeast
 NNW = North-northwest
 NW = Northwest
 S = South
 SE = Southeast
 SSE = South-southeast
 SSW = South-southwest
 SW = Southwest
 W = West
 WNW = West-northwest
 WSW = West-southwest

Appendix F
Model Input Summary

MODEL INPUT SUMMARY

Input Parameters for CAP88-PC for the Radionuclide Air Emission Annual Report For Calendar Year 1999

FACILITY INFORMATION

Dataset date: Model supplies date and time of dataset generation from its internal clock.
Facility: Rocky Flats Environmental Technology Site
City: Golden
State: Colorado
Zip Code: 80403-8200
Emission Year: 1999
Source Category: Former Nuclear Weapons Facility
Comments: Radionuclide air emissions for the 1999 Annual Air Emission Report required under 40 CFR 61, Subpart H

RUN INFORMATION

Run Type: Individual (Model is run to calculate dose to maximally exposed individual [MEI], not to a population.)
Distances: Varies (Each specific distance from the source to the receptor is entered; see Tables 4-2 through 4-8.)
Generate genetic Effects? YES
Create Dose & Risk Factor file? YES
Create Concentration Table file? YES
Create Chi/Q Table File? YES

METEOROLOGICAL DATA

Wind file to use: RFP99, wind file generated from on-Site meteorological data for calendar year 1999.
Annual Precipitation: 45.24 cm
Annual Ambient Temperature: 10.48°C
Height of Lid: 1,405 m (Value is an annual average of mixing heights formerly measured at Stapleton International Airport. Stapleton is the closest location that has historically measured mixing height.)

(Continued)

SOURCE DATA

Source Type: Area or Stack
Number of Sources: 1
Height: Varies (0 for area source, specific stack height is entered for stack sources; see Tables 4-2 and 4-8.)
Diameter (Stack sources only): Varies (Specific stack diameter is entered here; see Table 4-2.)
Area (Area sources only): Varies (Specific area of source is entered here; see Tables 4-3 through 4-8.)
Plume rise: Momentum
Exit Velocity: Varies (0 for area source, specific exit velocity is entered for stack sources; see Tables 4-2 and 4-8.)

AGRICULTURAL DATA

Source: Urban (The rest of the values used on this screen are defaults.)

RADIONUCLIDE LIST

Nuclide Varies (Radionuclide used corresponds to the source and isotope being modeled.)
Ci/y: Varies (Release rate corresponds to the source being modeled; see Tables 3-1 through 3-3.)

SIZE & CLASS DATA

Nuclide: Varies (Radionuclide used corresponds to the source and isotope being modeled.)
Size: Default
Class: Default

Appendix G

Corrected Effluent Information System (EIS) Data 1995 Through 1998

**Summary Table for the EIS-ODIS Report
1995-Release**

95_ODIS Location	ODIS Location Code	N	Effluent Volume (m ³)	Plutonium-238 (Ci)	Plutonium-239 (Ci)	Americium-241 (Ci)	Uranium-233/234 (Ci)	Uranium-238 (Ci)	Tritium (Ci)	Beryllium (Grams)
707-101	AFGHB707005	11	1.097E+07	-8.438E-13	3.961E-11	-2.045E-11	6.142E-11	1.165E-10	-	4.983E-04
707-102	AFGHB707006	11	1.471E+07	-1.391E-11	7.832E-11	-2.008E-11	9.560E-11	2.532E-10	6.930E-05	3.950E-04
707-105	AFGHB707003	11	9.319E+07	-1.306E-11	6.107E-10	3.688E-10	5.830E-09	5.937E-09	--	3.547E-03
707-106	AFGHB707001	11	2.565E+07	8.794E-12	1.943E-10	1.485E-11	1.219E-10	4.858E-10	--	9.540E-04
707-107	AFGHB707004	11	1.772E+08	-1.325E-10	7.505E-10	2.228E-10	1.067E-08	1.196E-08	--	3.492E-02
707-108	AFGHB707002	11	1.092E+08	-3.968E-11	1.426E-09	1.793E-09	4.941E-09	5.575E-09	--	1.797E-02
707-R21	AFGHI707001	10	4.539E+08	6.531E-13	2.328E-09	4.943E-09	1.380E-08	1.998E-08	--	2.037E-02
707-R22	AFGHI707002	10	4.539E+08	-3.475E-11	2.228E-09	6.688E-09	2.031E-08	2.326E-08	--	2.102E-02
707-R23	AFGHI707003	10	4.539E+08	6.064E-10	2.388E-09	3.876E-09	1.550E-08	1.918E-08	--	2.059E-02
707-R24	AFGHI707004	10	4.539E+08	6.461E-11	2.316E-09	4.169E-09	1.624E-08	2.037E-08	--	1.812E-02
707-R25	AFGHI707005	10	4.539E+08	1.057E-09	1.395E-09	2.840E-09	7.487E-09	8.437E-09	--	1.587E-02
707-R26	AFGHI707006	10	4.539E+08	1.852E-10	1.612E-09	4.383E-09	1.781E-08	2.709E-08	--	1.780E-02
707-R27	AFGHI707007	10	3.340E+08	7.838E-11	3.324E-09	1.486E-09	-3.085E-08	-2.804E-08	--	1.677E-02
707-R45	AFGHI707008	10	4.539E+08	-8.169E-11	2.407E-09	3.588E-09	1.735E-08	2.129E-08	--	1.791E-02
707-R46	AFGHI707009	9	4.539E+08	-6.349E-12	2.529E-09	2.502E-09	1.764E-08	2.092E-08	--	1.973E-02
779-782	AFGHF779002	12	5.959E+08	-1.901E-10	3.089E-09	2.978E-09	3.919E-08	4.311E-08	1.614E-03	1.121E-01
779-729	AFGHF779001	12	1.457E+08	3.255E-12	1.144E-09	6.599E-11	1.775E-09	4.699E-10	--	2.744E-02
776-201	AFGHE776003	12	6.131E+06	-7.156E-12	6.614E-11	4.632E-13	6.750E-11	1.058E-10	--	8.214E-04
776-202	AFGHE776008	12	6.278E+07	1.191E-11	1.061E-09	9.984E-11	5.694E-10	1.400E-09	--	1.786E-03
776-204	AFGHE776005	12	1.623E+08	-1.193E-10	1.980E-09	5.808E-10	1.166E-08	1.325E-08	--	3.441E-02
776-205	AFGHE776004	12	8.540E+07	-3.456E-11	5.529E-10	5.297E-11	4.871E-10	1.008E-09	3.220E-04	1.568E-02
776-206	AFGHE776002	12	8.091E+07	4.407E-11	1.172E-09	6.945E-11	1.546E-09	2.066E-09	1.061E-03	2.704E-03
776-207	AFGHE776009	12	5.984E+07	-1.067E-10	5.271E-10	5.020E-11	8.741E-10	1.618E-09	--	1.946E-03
776-250	AFGHE776001	20	3.133E+08	-2.111E-10	1.381E-09	3.930E-09	1.728E-08	2.162E-08	1.895E-03	1.270E-02
776-251	AFGHE776006	10	3.471E+08	-1.725E-10	1.312E-09	1.215E-09	2.952E-08	3.566E-08	1.307E-03	6.301E-02
776-252	AFGHE776007	10	9.185E+07	-8.469E-11	5.225E-10	5.817E-10	3.706E-09	3.696E-09	--	3.115E-03
559-561	AFGHA559001	12	5.732E+08	-7.576E-11	2.468E-09	7.033E-10	2.949E-08	3.514E-08	--	2.045E-02

(Continued)										
778-LDY	AFGHH778001	10	2.239E+08	2.088E-09	6.539E-08	7.567E-09	2.200E-08	1.019E-07	--	8.309E-03
771-MAI	AFGHC771001	11	2.008E+09	2.567E-09	1.524E-07	3.093E-08	1.038E-07	1.122E-07	--	4.353E-01
771-CMA	AFGHC771002	10	7.688E+07	7.954E-12	1.456E-09	1.043E-09	3.191E-09	4.127E-09	--	1.781E-03
771-CRM	AFGHC771005	9	9.349E+07	4.427E-10	4.313E-08	2.009E-09	6.113E-09	7.516E-09	--	3.208E-03
774-202	AFGHD774001	12	7.545E+07	1.692E-11	2.591E-10	1.051E-10	-7.839E-10	2.781E-11	--	2.149E-03
444-MAI	AFGHN444004	9	1.413E+09	--	--	--	9.642E-08	1.014E-07	--	2.838E-02
444-D05	AFGHN444003	10	1.649E+08	--	--	--	-1.408E-08	-1.314E-08	--	2.469E-02
447-MAI	AFGHO447001	10	7.931E+08	--	--	--	7.263E-08	7.976E-08	--	1.217E-01
865-EEE	AFGHP865001	10	4.283E+08	--	--	--	3.460E-08	3.692E-08	--	6.291E-02
865-WWW	AFGHP865002	10	7.098E+08	--	--	--	6.793E-08	7.184E-08	--	1.091E-01
886-875	AFGHS886001	10	1.220E+08	-2.436E-11	3.354E-10	1.072E-09	5.411E-09	7.359E-09	--	3.619E-03
881-ANX	AFGHQ881002	0	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	--	0.000E+00
881-MAI	AFGHQ881001	40	4.107E+09	-1.277E-09	1.727E-08	2.960E-08	3.567E-07	3.740E-07	--	7.055E-01
883-AAA	AFGHR883001	10	8.153E+08	--	--	--	6.945E-08	6.905E-08	--	1.174E-01
883-BBB	AFGHR883002	10	1.137E+09	--	--	--	8.220E-08	9.615E-08	--	1.742E-01
883-CCC	AFGHR883003	10	2.465E+08	--	--	--	2.403E-08	3.717E-08	--	4.294E-02
889-MAI	AFGHT889001	10	8.995E+07	1.635E-11	4.793E-10	3.055E-10	-6.405E-09	-5.539E-09	--	1.123E-02
991-985	AFGHU991001	10	1.380E+08	6.358E-11	4.577E-09	5.394E-09	1.165E-08	8.278E-09	--	5.287E-03
374-MAI	AFGHJ374001	12	3.468E+08	-2.682E-11	3.996E-09	1.936E-09	-6.957E-09	-1.012E-09	--	6.223E-02
991-MAI	AFGHU991002	10	1.092E+08	-3.775E-11	3.557E-10	8.466E-10	8.478E-09	8.857E-09	--	2.594E-03
371-NNN	AFGHC371001	24	5.636E+08	1.343E-10	6.657E-09	1.624E-09	3.343E-08	3.706E-08	--	1.719E-02
371-SSS	AFGHC371002	12	3.204E+08	-4.197E-11	2.733E-09	6.876E-10	1.792E-08	2.166E-08	--	1.076E-02
374-SPD	AFGHD374002	10	9.266E+07	5.553E-11	2.157E-09	1.843E-09	6.769E-09	7.595E-09	--	2.987E-03
RFETS		572	2.099E+10	4.720E-09	3.401E-07	1.321E-07	1.248E-06	1.479E-06	6.268E-03	2.476E+00

Notes:

Ci	=	Curies
EIS	=	Effluent Information System
m ³	=	Cubic meters
N	=	Number of filters analyzed
ODIS	=	Off-Site Discharge Information System
RFETS	=	Rocky Flats Environmental Technology Site
--	=	Not analyzed

**Summary Table for the EIS-ODIS Report
1996-Release**

96_ODIS Location	ODIS Location Code	N	Effluent Volume (m ³)	Plutonium-238 (Ci)	Plutonium-239 (Ci)	Americium-241 (Ci)	Uranium-233/234 (Ci)	Uranium-238 (Ci)	Tritium (Ci)	Beryllium (Grams)
707-101	AFGHB707005	11	9.836E+06	6.229E-11	1.769E-10	6.726E-11	-3.895E-10	-3.964E-10	-	0.000E+00
707-102	AFGHB707006	11	1.613E+07	9.611E-11	1.083E-10	2.642E-11	-1.038E-09	-1.253E-09	6.500E-05	0.000E+00
707-105	AFGHB707003	11	8.156E+07	1.222E-10	5.331E-10	1.824E-10	3.008E-09	2.358E-09	--	0.000E+00
707-106	AFGHB707001	11	2.234E+07	9.831E-11	1.534E-10	1.545E-10	-3.333E-10	-7.735E-10	--	0.000E+00
707-107	AFGHB707004	11	1.681E+08	3.070E-10	9.814E-10	7.956E-10	6.798E-09	5.098E-09	--	5.343E-03
707-108	AFGHB707002	11	8.362E+07	-1.412E-11	5.859E-10	2.829E-10	3.657E-09	3.463E-09	--	0.000E+00
707-R21	AFGHI707001	1	4.502E+08	6.467E-13	2.192E-09	5.313E-09	-1.382E-08	-1.004E-08	--	0.000E+00
707-R22	AFGHI707002	1	4.502E+08	-4.573E-10	7.857E-10	4.571E-09	-1.248E-08	-1.178E-08	--	0.000E+00
707-R23	AFGHI707003	1	4.502E+08	-5.795E-11	1.069E-09	4.152E-09	-1.044E-08	-1.453E-08	--	0.000E+00
707-R24	AFGHI707004	1	4.502E+08	-1.656E-10	1.844E-09	4.559E-09	-1.352E-08	-1.082E-08	--	0.000E+00
707-R25	AFGHI707005	1	4.502E+08	-4.005E-10	4.803E-10	4.957E-09	-3.108E-09	-7.699E-09	--	0.000E+00
707-R26	AFGHI707006	1	4.502E+08	-4.373E-10	1.707E-09	4.526E-09	-1.448E-08	-1.916E-08	--	0.000E+00
707-R27	AFGHI707007	1	4.502E+08	-1.951E-10	3.582E-09	4.513E-09	-1.028E-08	-8.033E-09	--	0.000E+00
707-R45	AFGHI707008	11	4.123E+08	6.179E-10	2.576E-09	2.121E-09	-2.200E-09	-3.254E-09	--	0.000E+00
707-R46	AFGHI707009	1	4.502E+08	-3.552E-10	1.379E-09	1.111E-08	-2.523E-09	-3.793E-09	--	0.000E+00
779-782	AFGHF779002	12	5.966E+08	3.802E-10	5.991E-09	2.471E-09	2.476E-08	2.641E-08	1.650E-03	2.068E-02
779-729	AFGHF779001	12	1.523E+08	7.308E-10	7.871E-10	1.188E-10	-3.586E-09	-3.055E-09	--	5.511E-03
776-201	AFGHE776003	12	6.659E+06	1.784E-11	5.498E-11	2.679E-11	-9.628E-11	-9.318E-11	--	2.094E-04
776-202	AFGHE776008	12	6.543E+07	3.534E-10	1.887E-09	4.783E-10	-4.557E-12	-6.212E-10	--	0.000E+00
776-204	AFGHE776005	12	1.636E+08	1.251E-10	2.372E-09	7.987E-10	6.793E-09	6.686E-09	--	6.730E-03
776-205	AFGHE776004	12	9.574E+07	1.428E-10	1.120E-09	3.578E-10	-1.148E-09	-1.499E-09	4.050E-04	2.429E-03
776-206	AFGHE776002	12	7.907E+07	4.990E-10	4.334E-09	3.742E-10	-3.129E-10	-1.140E-09	1.239E-03	0.000E+00
776-207	AFGHE776009	12	6.104E+07	2.663E-10	3.175E-10	2.897E-10	-4.093E-09	-4.411E-09	--	0.000E+00
776-250	AFGHE776001	8	4.881E+08	3.701E-09	6.854E-08	1.077E-07	-3.569E-08	-1.639E-07	1.251E-03	0.000E+00
776-251	AFGHE776006	1	3.318E+08	-9.977E-11	-1.271E-10	-1.051E-09	-4.759E-08	-4.721E-08	6.090E-04	0.000E+00
776-252	AFGHE776007	1	8.779E+07	-5.099E-11	9.794E-11	1.361E-09	-1.073E-09	-1.697E-09	--	0.000E+00
559-561	AFGHA559001	12	5.950E+08	-5.027E-11	1.736E-08	1.041E-08	3.684E-08	4.459E-08	--	0.000E+00

(Continued)										
778-LDY	AFGHH778001	1	2.140E+08	2.690E-09	1.216E-07	9.462E-09	1.107E-07	7.152E-07	--	0.000E+00
771-MAI	AFGHC771001	12	1.987E+09	3.335E-08	6.619E-07	1.224E-07	-8.352E-09	1.753E-08	--	5.335E-02
771-CMA	AFGHC771002	1	7.055E+07	-4.084E-13	2.291E-09	2.967E-09	8.141E-10	1.131E-08	--	0.000E+00
771-CRM	AFGHC771005	1	8.580E+07	-1.603E-10	2.395E-09	4.308E-09	-1.163E-10	9.357E-09	--	0.000E+00
774-202	AFGHD774001	12	7.258E+07	-1.036E-11	6.655E-10	9.432E-10	-1.315E-09	-1.006E-09	--	0.000E+00
444-MAI	AFGHN444004	1	1.364E+09	--	--	--	-7.482E-08	-5.620E-08	--	0.000E+00
444-D05	AFGHN444003	1	1.593E+08	--	--	--	4.350E-09	3.946E-09	--	0.000E+00
447-MAI	AFGHO447001	1	7.660E+08	--	--	--	-2.509E-09	3.546E-10	--	0.000E+00
865-EEE	AFGHP865001	1	4.137E+08	--	--	--	-1.216E-08	-1.195E-08	--	0.000E+00
865-WWW	AFGHP865002	1	6.856E+08	--	--	--	-2.302E-08	8.963E-09	--	0.000E+00
886-875	AFGHS886001	12	1.204E+08	8.687E-10	9.144E-10	3.558E-10	-3.005E-09	-4.387E-09	--	0.000E+00
881-ANX	AFGHQ881002	0	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	--	0.000E+00
881-MAI	AFGHQ881001	4	3.966E+09	-5.708E-09	1.307E-07	9.726E-09	8.946E-08	8.084E-07	--	0.000E+00
883-AAA	AFGHR883001	1	7.875E+08	--	--	--	-1.734E-08	-2.077E-08	--	0.000E+00
883-BBB	AFGHR883002	1	1.098E+09	--	--	--	-9.560E-09	-1.082E-08	--	0.000E+00
883-CCC	AFGHR883003	1	2.381E+08	--	--	--	9.498E-09	1.374E-08	--	0.000E+00
889-MAI	AFGHT889001	1	8.688E+07	-5.821E-12	4.355E-10	2.651E-10	8.839E-09	9.581E-09	--	0.000E+00
991-985	AFGHU991001	1	1.266E+08	4.428E-11	6.996E-10	-1.482E-10	-2.219E-08	-2.180E-08	--	0.000E+00
374-MAI	AFGHJ374001	12	3.269E+08	8.407E-10	4.258E-09	1.154E-09	7.005E-09	5.527E-09	--	9.730E-03
991-MAI	AFGHU991002	1	1.002E+08	-9.846E-12	6.302E-10	-9.630E-10	-8.158E-09	-5.803E-09	--	0.000E+00
371-NNN	AFGHC371001	24	5.593E+08	2.034E-09	4.153E-09	2.157E-09	1.786E-08	1.652E-08	--	0.000E+00
371-SSS	AFGHC371002	12	2.884E+08	6.564E-11	1.264E-09	8.272E-10	8.899E-09	9.552E-09	--	0.000E+00
374-SPD	AFGHD374002	1	8.834E+07	7.209E-11	3.489E-09	2.138E-09	-1.660E-09	1.060E-10	--	0.000E+00
RFETS		306	2.073E+10	3.931E-08	1.056E-06	3.263E-07	-2.315E-08	1.271E-06	5.219E-03	1.040E-01

Notes:

- Ci = Curies
- EIS = Effluent Information System
- m³ = Cubic meters
- N = Number of filters analyzed
- ODIS = Off-Site Discharge Information System
- RFETS = Rocky Flats Environmental Technology Site
- = Not analyzed

Summary Table For The EIS/ODIS Report^a
1997-Release

97_ODIS Location	ODIS Location Code	N	Effluent Volume (m ³)	Plutonium-239 (Ci)	Americium-241 (Ci)	Uranium-233/234 (Ci)	Uranium-235 (Ci)	Uranium-238 (Ci)	Tritium (Ci)
707-101	AFGHB707005	12	9.742E+06	3.435E-10	8.752E-11	-1.263E-10	2.160E-11	-2.490E-10	--
707-102	AFGHB707006	12	2.370E+07	3.561E-10	-1.420E-10	-1.379E-09	-4.033E-11	-4.175E-10	--
707-105	AFGHB707003	12	7.244E+07	2.315E-10	-7.559E-11	-2.530E-10	-4.300E-13	-5.151E-11	--
707-106	AFGHB707001	12	2.182E+07	1.785E-10	8.516E-11	-4.360E-10	3.122E-11	-6.553E-10	--
707-107	AFGHB707004	12	1.771E+08	1.988E-10	-4.149E-11	-2.545E-10	2.836E-10	-6.663E-10	--
707-108	AFGHB707002	12	8.990E+07	6.464E-10	8.883E-11	-4.687E-10	-1.976E-11	-6.773E-10	--
707-R21	AFGHI707001	1	4.453E+08	-9.298E-11	-2.790E-10	2.236E-09	6.340E-11	7.270E-10	--
707-R22	AFGHI707002	1	4.453E+08	3.302E-10	-3.895E-10	7.959E-10	-2.540E-11	2.409E-09	--
707-R23	AFGHI707003	1	4.453E+08	-4.230E-12	2.113E-11	1.141E-09	-1.479E-10	1.428E-09	--
707-R24	AFGHI707004	1	4.453E+08	6.333E-11	-4.855E-10	5.742E-10	-3.377E-11	1.828E-09	--
707-R25	AFGHI707005	1	4.453E+08	-1.100E-10	-1.396E-10	4.780E-10	-6.345E-11	5.161E-10	--
707-R26	AFGHI707006	1	4.453E+08	5.495E-11	-4.903E-10	1.293E-09	-8.877E-11	1.179E-09	--
707-R27	AFGHI707007	1	4.453E+08	5.292E-10	-3.810E-10	6.773E-10	-3.217E-10	1.367E-09	--
707-R45	AFGHI707008	8	4.453E+08	8.399E-10	3.314E-10	-2.848E-09	-3.690E-12	-1.667E-10	--
707-R46	AFGHI707009	1	4.453E+08	1.563E-10	-2.535E-10	2.248E-09	-2.577E-10	2.467E-09	--
779-782	AFGHF779002	12	6.049E+08	5.668E-09	-9.506E-10	-4.484E-09	5.727E-10	1.389E-09	2.527E-03
779-729	AFGHF779001	12	1.722E+08	7.155E-10	-3.357E-10	-1.148E-09	-1.767E-10	-5.422E-10	--
776-201	AFGHE776003	12	7.580E+06	5.459E-10	4.626E-11	1.536E-10	3.235E-11	9.076E-11	--
776-202	AFGHE776008	12	7.229E+07	3.310E-09	4.013E-09	-5.670E-10	5.949E-11	-4.882E-10	--
776-204	AFGHE776005	12	1.587E+08	3.013E-09	3.709E-11	-5.693E-10	3.886E-10	2.488E-11	--
776-205	AFGHE776004	12	1.072E+08	1.178E-09	5.119E-10	-5.781E-10	-1.272E-10	-7.795E-10	3.759E-04
776-206	AFGHE776002	12	7.709E+07	3.394E-09	1.274E-09	-9.200E-10	-1.153E-10	8.475E-10	2.323E-03
776-207	AFGHE776009	12	6.613E+07	1.539E-09	1.105E-10	-6.300E-10	3.315E-10	-8.273E-10	--
776-250	AFGHE776001	8	3.782E+08	2.056E-08	-2.979E-09	4.230E-08	1.689E-09	5.118E-08	2.771E-03
776-251	AFGHE776006	1	3.282E+08	3.281E-10	4.141E-10	-3.790E-10	-3.190E-12	2.637E-09	1.313E-03

(Continued)									
776-252	AFGHE776007	1	8.708E+07	1.137E-10	8.454E-12	-1.644E-10	-4.790E-11	7.421E-11	--
559-561 ^b	AFGHA559001	12	6.486E+08	4.417E-09	7.062E-11	8.821E-09	6.147E-10	8.513E-09	--
778-LDY	AFGHH778001	1	1.000E+02	6.100E-14	2.500E-14	2.200E-14	1.000E-15	1.340E-13	--
771-MAI ^c	AFGHC771001	12	2.205E+09	1.037E-07	6.902E-09	-1.839E-07	-6.438E-09	-1.923E-07	--
771-CMA	AFGHC771002	1	6.997E+07	1.305E-10	4.294E-11	1.844E-10	-2.442E-11	5.532E-10	--
771-CRM	AFGHC771005	1	8.510E+07	1.276E-09	2.184E-10	4.194E-10	-2.374E-11	7.802E-10	--
774-202 ^c	AFGHD774001	12	7.617E+07	1.277E-09	2.212E-10	-1.874E-10	8.497E-11	2.146E-10	--
444-MAI	AFGHN444004	1	1.353E+09	7.516E-10	3.695E-09	1.810E-09	3.176E-11	1.874E-09	--
444-D05	AFGHN444003	1	1.580E+08	1.194E-11	-1.582E-10	-2.537E-10	1.821E-10	8.416E-10	--
447-MAI	AFGHO447001	1	7.597E+08	3.264E-10	-4.984E-10	-2.884E-09	-3.661E-10	-3.709E-09	--
865-EEE	AFGHP865001	1	4.103E+08	6.001E-10	-2.945E-10	-1.394E-09	4.324E-10	-1.174E-09	--
865-WWW	AFGHP865002	1	6.799E+08	3.985E-10	1.328E-10	-2.940E-09	1.364E-09	-7.728E-10	--
886-875	AFGHS886001	12	1.168E+08	5.454E-10	1.000E-10	-7.479E-10	3.819E-10	-1.228E-09	--
881-ANX	AFGHQ881002	0	--	--	--	--	--	--	--
881-MAI	AFGHQ881001	4	3.923E+09	8.086E-09	-1.833E-08	-7.053E-08	-4.156E-09	-7.070E-08	--
883-AAA	AFGHR883001	1	7.810E+08	1.137E-10	-1.806E-10	-5.620E-10	1.204E-10	-2.944E-10	--
883-BBB	AFGHR883002	1	1.089E+09	1.338E-10	-7.026E-10	2.295E-09	5.286E-10	4.530E-09	--
883-CCC	AFGHR883003	1	2.361E+08	5.942E-10	-3.489E-10	-3.189E-09	-2.562E-10	-3.843E-09	--
889-MAI	AFGHT889001	0	--	--	--	--	--	--	--
991-985	AFGHU991001	1	1.256E+08	2.323E-09	-4.241E-10	-1.818E-09	3.029E-10	5.635E-09	--
374-MAI ^b	AFGHJ374001	12	3.666E+08	2.034E-08	2.185E-09	-3.327E-09	1.419E-09	8.053E-10	--
991-MAI	AFGHU991002	1	9.940E+07	1.464E-08	1.160E-10	1.137E-09	-9.980E-10	1.383E-08	--
371-NNN	AFGHC371001	24	6.284E+08	4.359E-09	1.068E-09	-5.953E-09	1.493E-09	-2.711E-09	--
371-SSS	AFGHC371002	12	2.879E+08	7.547E-10	-8.670E-12	4.640E-10	8.458E-11	1.079E-09	--
374-SPD	AFGHD374002	1	9.577E+07	1.296E-09	6.964E-10	8.118E-10	3.133E-11	8.189E-10	--
RFETS		308	2.066E+10	2.101E-07	-5.412E-09	-2.250E-07	-3.191E-09	-1.746E-07	9.309E-03

^a Did not analyze for Pu-238 in 1997.

^b Shrouded probe data used for this location in November and December.

^c Shrouded probe data used for this location in December.

Notes:

Ci = Curies
 EIS = Effluent Information System
 m³ = Cubic meters
 N = Number of filters analyzed

ODIS = Off-Site Discharge Information System
 RFETS = Rocky Flats Environmental Technology Site
 -- = Not analyzed

Summary Table For The EIS/ODIS Report^a
1998-Release

98_ODIS Location	ODIS Location Code	N	Effluent Volume (m ³)	Plutonium-239 (Ci)	Americium-241 (Ci)	Uranium-233/234 (Ci)	Uranium-235 (Ci)	Uranium-238 (Ci)	Tritium (Ci)
707-101	AFGHB707005	12	8.566E+06	1.109E-10	1.240E-11	1.387E-10	6.946E-11	1.816E-10	--
707-102	AFGHB707006	12	2.170E+07	2.196E-10	2.187E-10	7.741E-10	2.043E-10	4.013E-10	--
707-105	AFGHB707003	12	7.548E+07	7.408E-10	-1.989E-10	2.762E-09	1.212E-09	1.356E-09	--
707-106	AFGHB707001	12	2.832E+07	4.611E-10	1.169E-10	1.079E-09	2.390E-10	6.107E-10	--
707-107	AFGHB707004	12	1.819E+08	1.039E-09	1.448E-09	8.297E-09	1.202E-09	1.136E-08	--
707-108	AFGHB707002	12	1.004E+08	1.014E-09	3.124E-10	3.534E-09	1.013E-09	2.720E-09	--
707-R21	AFGHI707001	1	4.453E+08	4.694E-10	-2.292E-09	6.513E-10	-4.018E-10	-3.180E-09	--
707-R22	AFGHI707002	1	4.453E+08	2.618E-09	8.881E-10	1.751E-09	1.692E-11	-1.104E-09	--
707-R23	AFGHI707003	1	4.453E+08	3.341E-10	-8.205E-10	-4.652E-11	-6.217E-10	-3.316E-09	--
707-R24	AFGHI707004	1	4.453E+08	9.389E-10	2.030E-10	-2.000E-09	-1.015E-10	-1.480E-09	--
707-R25	AFGHI707005	1	4.453E+08	2.030E-10	-1.226E-10	-2.229E-09	-1.184E-10	-3.920E-09	--
707-R26	AFGHI707006	1	4.453E+08	1.226E-10	-1.045E-09	-5.963E-10	4.610E-10	-3.349E-09	--
707-R27	AFGHI707007	1	4.453E+08	1.916E-09	-1.019E-09	-3.616E-09	-5.075E-11	-4.614E-09	--
707-R45	AFGHI707008	1	4.453E+08	8.458E-11	-9.854E-10	-2.550E-09	-2.538E-10	-3.180E-09	--
707-R46	AFGHI707009	1	4.453E+08	-2.495E-10	-4.060E-10	-2.034E-09	3.595E-10	-3.333E-09	--
779-782	AFGHF779002	12	6.170E+08	6.436E-09	9.996E-12	-1.015E-08	9.578E-10	-1.858E-08	--
779-729	AFGHF779001	12	1.658E+08	7.792E-10	-5.088E-10	-2.938E-09	4.076E-10	-3.229E-09	--
776-201	AFGHE776003	12	6.915E+06	3.917E-11	3.338E-11	1.944E-10	4.829E-11	1.768E-10	--
776-202	AFGHE776008	12	7.276E+07	9.027E-10	-5.400E-11	-1.419E-10	-7.093E-11	-5.094E-10	--
776-204	AFGHE776005	12	1.613E+08	6.663E-10	1.925E-09	9.291E-09	6.845E-10	6.287E-09	--
776-205 ^b		12	2.320E+08	3.116E-09	1.990E-09	4.611E-09	1.514E-09	4.259E-09	
776-205T ^c	AFGHE776004		--	--	--	--	--	--	2.669E-04
776-206T ^c	AFGHE776002		--	--	--	--	--	--	2.040E-03
776-250	AFGHE776001	1	3.923E+08	3.992E-08	-3.843E-09	5.423E-09	-1.494E-09	-8.027E-09	7.653E-04

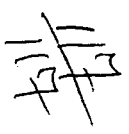
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(Continued)									
776-251	AFGHE776006	1	3.282E+08	8.405E-10	-1.681E-09	-1.350E-09	4.457E-11	-3.171E-09	6.375E-04
776-252	AFGHE776007	1	8.684E+07	6.829E-08	8.138E-09	-1.021E-10	-5.146E-11	-7.667E-10	--
559-561	AFGHA559001	12	5.898E+08	4.863E-09	-2.216E-09	7.593E-09	4.321E-09	1.051E-08	--
778-LDY	AFGHH778001	0	--	--	--	--	--	--	--
771-MAI	AFGHC771001	12	2.453E+09	1.457E-08	2.244E-11	2.964E-08	2.054E-08	1.187E-08	--
771-CMA	AFGHC771002	1	6.978E+07	4.880E-09	5.360E-10	-1.792E-10	-2.104E-11	-4.056E-10	--
771-CRM	AFGHC771005	1	8.486E+07	7.623E-09	1.767E-09	1.299E-10	8.078E-11	-6.795E-10	--
774-202	AFGHD774001	12	8.406E+07	1.478E-10	-8.560E-12	-7.615E-11	7.738E-10	-4.228E-10	--
444-MAI	AFGHN444004	1	1.346E+09	6.146E-09	-3.412E-09	-2.948E-09	1.041E-09	-1.162E-08	--
444-DO5	AFGHN444003	1	1.571E+08	1.898E-11	-6.330E-12	-8.919E-10	5.060E-11	-2.451E-09	--
447-MAI	AFGHO447001	1	7.556E+08	3.349E-10	-1.785E-09	-6.430E-09	-2.203E-10	-9.805E-09	--
865-EEE	AFGHP865001	1	4.080E+08	2.100E-09	-1.308E-09	-5.014E-09	-3.628E-10	-7.970E-09	--
865-WWW	AFGHP865002	1	6.762E+08	-2.857E-10	-1.524E-10	-9.471E-09	-8.252E-11	-1.388E-08	--
886-875	AFGHS886001	1	1.162E+08	3.629E-10	8.592E-10	4.433E-10	3.923E-10	5.394E-10	--
881-ANX	AFGHQ881002	0	--	--	--	--	--	--	--
881-MAI	AFGHQ881001	4	3.923E+09	1.839E-08	-2.305E-08	3.257E-09	-2.825E-09	-3.502E-08	--
883-AAA	AFGHR883001	1	7.768E+08	1.339E-10	-8.166E-10	-7.704E-09	1.272E-10	1.647E-09	--
883-BBB	AFGHR883002	1	1.083E+09	1.313E-09	-1.387E-09	-9.298E-09	8.709E-11	-1.259E-08	--
883-CCC	AFGHR883003	1	2.348E+08	1.119E-09	-1.924E-09	-7.956E-09	-7.228E-10	-2.940E-09	--
889-MAI	AFGHT889001	0	--	--	--	--	--	--	--
991-985	AFGHU991001	0	--	--	--	--	--	--	--
374-MAI	AFGHJ374001	12	3.353E+08	3.196E-09	1.121E-09	2.676E-09	6.028E-10	-7.736E-10	--
991-MAI	AFGHU991002	0	--	--	--	--	--	--	--
371-NNN	AFGHC371001	24	5.242E+08	1.838E-08	1.245E-09	-9.648E-09	2.842E-09	-1.300E-08	--
371-SSS	AFGHC371002	12	2.990E+08	6.923E-10	-4.174E-10	-2.557E-09	3.109E-10	-3.439E-09	--
374-SPD	AFGHD374002	1	8.737E+07	2.231E-09	3.574E-09	2.852E-10	2.800E-11	5.650E-10	--
779-404 ^d		2	4.704E+07	3.414E-10	1.235E-10	1.574E-09	6.868E-10	4.747E-10	--
RFETS		258	2.054E+10	2.176E-07	-2.492E-08	-5.824E-09	3.292E-08	-1.238E-07	3.709E-03

^a No longer report Pu-238.

^b Release points 776-205, -206, and -207 are combined through a mixing plenum and are sampled with one shrouded probe identified as 776-205.

^c The tritium sampling occurs before the mixing plenum described in footnote b. The location names have been


altered to denote them as tritium sampling points.

^d Plenum 779-404 is a new release point for 1998.

Notes:

Ci	=	Curies
EIS	=	Effluent Information System
m ³	=	Cubic meters
N	=	Number of filters analyzed
ODIS	=	Off-Site Discharge Information System
RFETS	=	Rocky Flats Environmental Technology Site
--	=	Not analyzed